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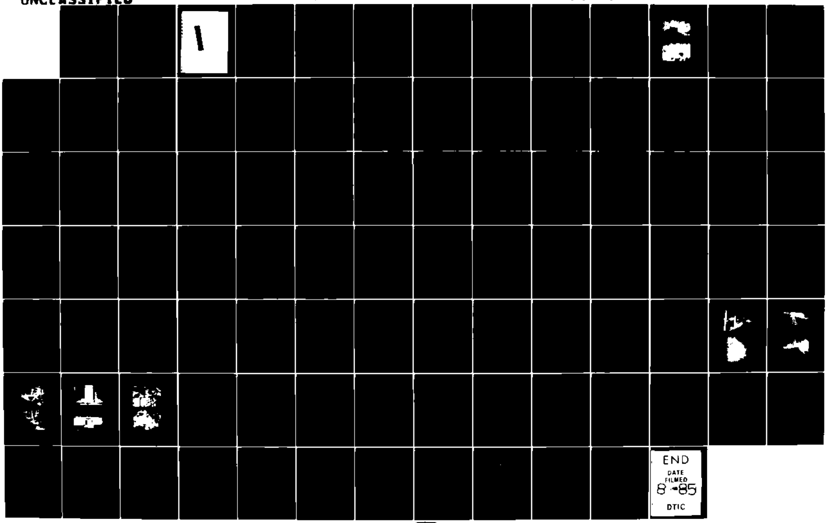

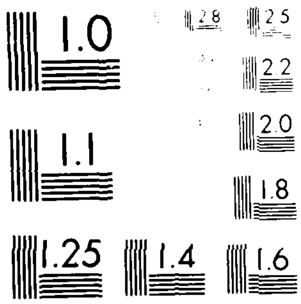
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number):

The dam is a 25 ft. high and 252 ft. long stone wall dam with uncemented joints constructed acroo s a steep sided valley reach on an unnamed brook. The dam is intermediate in size with a high hazard potential. The spillway is inadequate tp jandle the test flood and the dam would be overtopped by about 1.4 ft.

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SPRAGUE UPPER RESERVOIR DAM

RI 03105

PROVIDENCE RIVER BASIN
SMITHFIELD, RHODE ISLAND

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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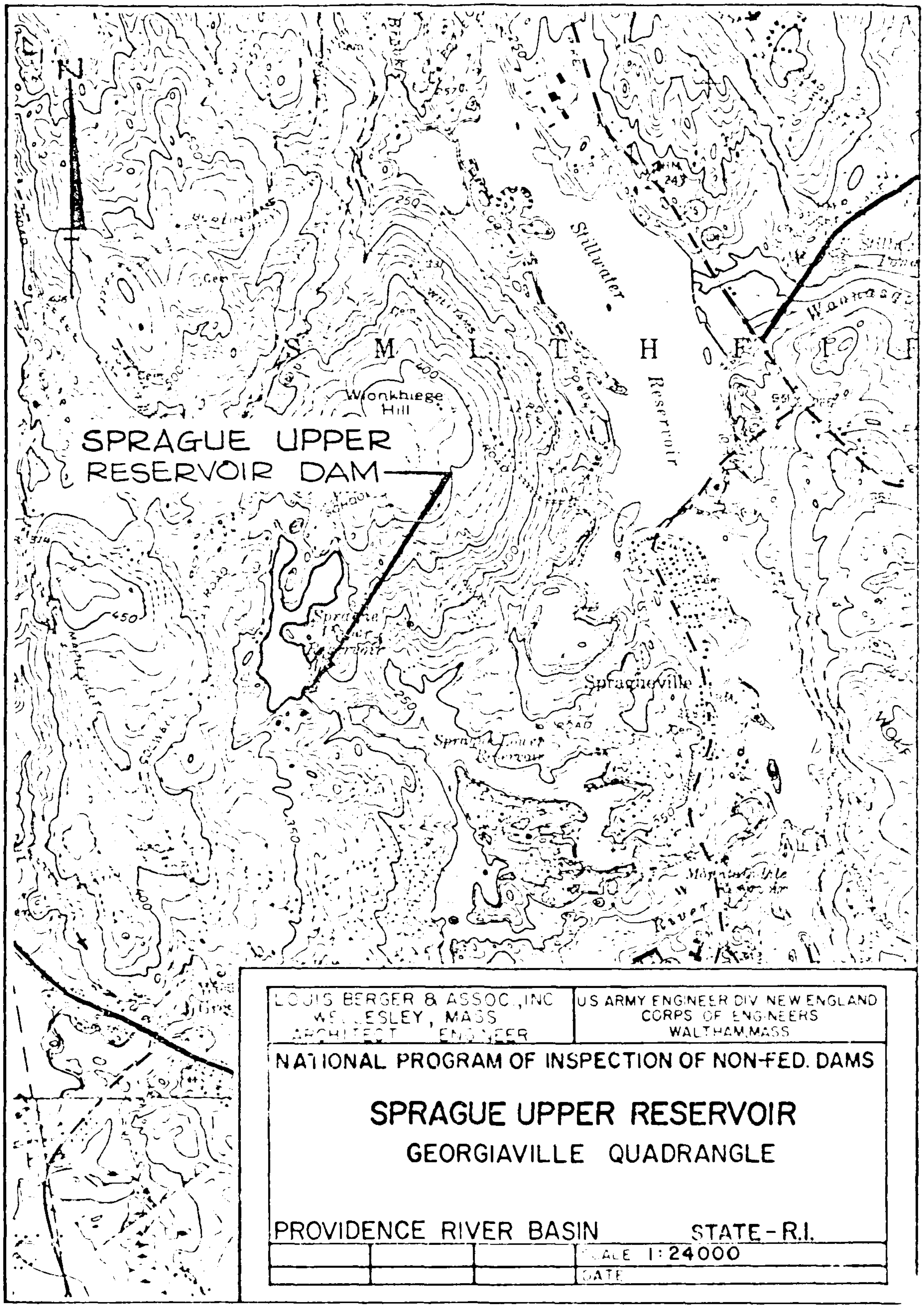
APPENDIXES

SPRAGUE UPPER RESERVOIR DAM

Overview from left abutment showing crest of dam

Overview from left abutment showing upstream slope of dam and gatehouse



LOUIS BERGER & ASSOC.,INC
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US ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM,MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SPRAGUE UPPER RESERVOIR
GEORGIAVILLE QUADRANGLE

PROVIDENCE RIVER BASIN STATE-R.I.

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DATE

PHASE I INSPECTION REPORT

SPRAGUE UPPER RESERVOIR DAM RI 03105

Section 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Rhode Island. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 19 March 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0051 has been assigned by the Corps of Engineers for this work.

b. Purpose.

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Sprague Upper Reservoir Dam is located between the communities of Spragueville and West Greenville in Smithfield, Providence County, Rhode Island. The dam is reached via State Highway 44, 3.2 miles west from I-295 in Greenville, north 0.8 miles on Mapleville Road and north 0.7 miles on Colwell Road. The dam is situated at the headwaters of an unnamed brook which flows from Sprague Upper Reservoir to Sprague Lower Reservoir. This unnamed brook then joins the Stillwater River, just west of Route 116. The Stillwater River is a tributary of the Woonasquatucket River which joins the Providence River about 12 miles downstream near the Providence Central Business District. The normal storage level of the reservoir is 321 MSL, while the confluence of the unnamed brook and the Stillwater River a mile downstream is at about 210 MSL

b. Description of Dam and Appurtenances.

(1) Description of Dam. Sprague Upper Reservoir Dam is a 25 ft. high and 252 ft. long stone wall dam with uncemented joints constructed across a steep-sided valley reach on an unnamed brook. The top thickness of the stone

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The field investigation revealed no significant displacements or distress that would warrant the preparation of stability computations based on assumed soil properties and engineering factors.

b. Design and Construction Data. No plans, specifications, or construction records of value to a stability assessment are known to exist.

c. Operating Records. There are no operating records of any significance to structural stability.

d. Post Construction Changes. There are several post construction changes made to the dam over the course of its history. The principal ones are as follows:

(1) A 16-inch outlet pipe was installed to a length of 14 feet inside the 2 ft. by 2.5 ft. stone box culvert.

(2) A concrete wall was built around the outlet pipe.

(3) A tile stack was added above the wood plank gate to the outlet pipe.

(4) A bentonitic clay fill was dumped on the upstream side of the gate.

(5) Openings in the concrete apron on the north side of the gatehouse were caulked and concreted.

e. Seismic Stability. The dam is located in seismic Zone No. 1 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

the rise in the Reservoir's water surface level and this flooding would be of a marginal nature.

With an outflow of 8,500 cfs from Sprague Lower Reservoir, the roadway leading to the Reservoir will be inundated. Route 116, (Pleasant View Avenue) will be inundated by the outflow as the box culvert under the roadway will only pass a discharge of approximately 2200 cfs before overtopping. This control point will cause a water surface rise of about 11 ft. above that which would be expected in the stream just prior to failure of the dam and would create backwater stages in the Stillwater River up to a depth of about 13 ft. An average cross section and slope on Stillwater River was computed, showing a stage of about 8 ft. for a discharge of 8,500 cfs. This stage is about 7 ft. higher than that which would be experienced just prior to failure of the dam, and would affect two structures, (one commercial and one home) located downstream of Route 116 with moderate flooding. As previously mentioned, about 2000 ft. beyond Route 116 the flow would enter the relatively large Stillwater Reservoir.

In summary about 8 homes, 2 commercial establishments, and 2 roadways, one of which is a state highway (Route 116) are within the area of potential flooding. Mountaindale Road near Stillwater Reservoir also might sustain damage as a result of a breach failure of Sprague Upper Reservoir. See Appendix D, Figure 4, Sheet D-18 which shows the area of potential flooding.

Discharge tables and curves for the spillway and for over the top of the dam are shown on Sheets D-7, D-8 and D-9 and Fig. 3 Sheet D-10, Appendix D.

Flood routings were performed for both 1/2 and full PMF. Results of these routings are shown on Sheets D-11, D-12, and D-13, and are summarized as follows:

Flood Magnitude	Max. Disch. cfs	Max. Res.El. ft.MSL	Max. Head Over Dam ft.	Max. Disch. Over Dam cfs.
1/2 PMF	610	325.2	1.0	420
PMF (TEST FLOOD)	1,120	325.6	1.4	890

From the above table, it can be seen that the project will not pass the test flood without overtopping the dam by 1.4 ft. The project, however, can handle 11% of the PMP flood without overtopping the dam.

Drawdown of the reservoir is not possible through the 16 in. dia. pipe as it is inoperable.

f. Dam Failure Analysis. As discussed above, the dam would be overtopped by the PMF test flood. Also, a breach owing to structural failure of the dam by piping or sloughing is a possibility. For this analysis a breach was assumed with the water level at the top of dam. The "rule of thumb" criteria suggested in the NED March 1978 Guidance Report was used for the breach analysis. With a breach width of 40 percent of the dam length equal to 56 feet, an outflow of about 11,800 cfs would be realized. (See Sheets D-14 thru D-17, Appendix D)

In the reaches below the breach the outflow first passes through Sprague Lower Reservoir, then along an unnamed stream for about 1000 ft. where it then joins the Stillwater River just above its crossing with Pleasant View Avenue (Route 116). About 2000 ft. below this point Stillwater River empties into Stillwater Reservoir where the entire volume from the breach could be stored.

The dam at the outlet of Sprague Lower Reservoir has been breached and has not been reconstructed. A control section at this point was taken and a stage discharge curve for this section was computed. The analysis indicated that the water level in Sprague Lower Reservoir would rise about 11 ft., with an outflow of about 8,500 cfs. Whereas, the water level in Sprague Lower Reservoir is believed to be below the elevation shown on the USGS Quadrangle Sheet because of Sprague Lower Reservoir's breached dam, only about six residential structures surrounding Sprague Lower Reservoir would be effected by

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Sprague Upper Reservoir Dam is an uncemented stone wall dam with an upstream earth fill impounding a normal storage of about 281 acre-ft. with provision for an additional 87 acre-ft. of capacity in its surcharge space to the top of the dam. It is basically a low surcharge - low spillage facility used for recreational purposes. The spillway is capable of discharging about 120 cfs with surcharge to the top of the dam. The general topographic characteristic of the 0.5 sq. mi. (319 acres) drainage basin is best described as rolling terrain. The drainage area measures about 1.1 miles long and 0.67 miles wide and rises from elevation 321.0 at the spillway crest to elevation 375 MSL. The area is generally forested.

b. Design Data. There is no design data available for this dam.

c. Experience Data. No records are available in regard to past operation of the reservoir, nor of surcharge encroachments and spills through the spillway. The maximum past inflows are unknown.

d. Visual Observations. There are no present evidences either along the reservoir or in the downstream channel to indicate high water levels or signs of major spillway outflows. No one contacted could recollect any such occurrences.

e. Test Flood Analysis. Reservoir area and capacity curves and tables, for use in flood routings, are shown on Fig. 2, Sheet D-5 and Sheet D-6, Appendix D. For determining surface areas and surcharge capacities, planimetered areas were taken from contours delineated on USGS 2,000 ft. per in. quadrangle sheets.

The test flood chosen to evaluate the hydrologic and hydraulic capacity of Sprague Upper Reservoir Dam was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as small in size with a high hazard potential, a test flood of magnitude corresponding to 1/2 PMF to full PMF could be selected for the evaluation. Due to the extensive residential and commercial areas that could be affected, a test flood of a full PMF was selected.

Precipitation data were obtained from Hydrometeorological Report No. 33, which for the Rhode Island area approximates 24.0 in. of 6 hour point rainfall over a 10 square mile area. This value was then reduced by 20 percent to allow for basin size, shape and fit factors. The 6 hour rainfall was distributed into one hour incremental periods as suggested in COE Publication EC 1110-2-1411. A constant loss factor of 0.1 in. per hour was deducted from the precipitation values to give the excess rainfall used to prepare an inflow hydrograph.

A triangular incremental unitgraph was assumed for the inflow hydrographs, using a computed lag time value of 1.90 hours to derive a time-to-peak for the triangular hydrograph of 1.8 hours (see computations on Sheets D-2 and D-3 Appendix D). A PMF inflow hydrograph is shown on Fig. 1, Sheet D-4, Appendix D, indicating a peak inflow of about 1,490 cfs or a CSM of about 2,980.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The Sprague Upper Reservoir facility is operated by personnel of the Greater Providence YMCA. There are no reservoir operations as the outlet gate is inoperable, nor are there documented operating procedures. The caretaker for the dam lives adjacent to Sprague Upper Reservoir and usually visits the dam daily in the summer and less frequently in the winter.

4.2 Maintenance of Dam

Little Maintenance is required except for periodic cutting of brush and tree growth on the dam crest. No documented maintenance instructions have been prepared.

4.3 Maintenance of Operating Facilities

Except for the maintenance noted above, no specific maintenance program is in effect. It is presumed that some maintenance to the gate has been performed in the past to keep the mechanisms operative. However, this has not been done for some time as the outlet gate is now inoperative.

4.4 Description of any Warning System in Effect

No warning system is in effect at Sprague Upper Reservoir Dam.

4.5 Evaluation

Although little is known about the construction of the facility, it has simple operating devices and, as such, requires no detailed operating procedures. Maintenance involves periodic growth removal from the embankment and surveillance regarding seeps, slope damage, animal burrows, etc. The outlet operating gate requires checking and repairs should be made as necessary. A formal warning system should be developed.

works are judged to be in very poor condition, owing to the lack of operative dewatering facilities and the presence of a sinkhole on the crest of the dam immediately above the outlet culvert. Although this depression is reported to have been there for a long time, it appears to have become significantly larger recently. This, in conjunction with the large volume of seepage, indicates that the structural integrity of the dam may be threatened. There is also extensive tree and brush growth on the crest of the dam.

dam axis for about 120 ft. It then cascades down a natural rock face to the valley below and into the unnamed brook leading into the lower reservoir. (See Photo Nos. 5 & 6, Appendix C)

The outlet for this project is located at mid-span of the dam. According to the plans of the Rhode Island Department of Public Works, Division of Harbors and Rivers, the outlet culvert is a 2 ft. by 2.5 ft. stone box culvert leading from the gatehouse on the upstream face. However, the actual outlet observed was a 16 in. dia. cast iron pipe. This pipe was apparently inserted into the stone box culvert to a length of approximately 10 ft. to 14 ft. in 1940 or earlier. A concrete headwall was then built around this pipe which measures 18 ft. wide and varies from 3.5 ft. to 4 ft. high. The outlet channel just downstream of the outlet pipe runs through a natural valley in the rock. This bedrock appears to be a weathered gneiss.

The gatehouse at the crest of the dam is over a wet well. According to an inspection report dated January 16, 1957, the upper end of the outlet pipe is covered with a plank gate set in steel channels that act as gate guides. A pre-existing valve stem made of wooden timbers rotted away and in 1957 was removed and replaced with 2 inch galvanized pipe. There is an intake stack consisting of three 12-inch vitrified tile pipes with a large copper screen installed over the intake stack. The inlet level is approximately 9 feet below the top of the Dam. The plank gate is inoperable. (See Drawings, Appendix B and Photo Nos. 7 & 8. Appendix C)

d. Reservoir Area. The shoreline of the reservoir upstream of the dam is very stable and bedrock is well exposed over perhaps 50 percent of the shore. No evidence of slides or other problems were noted.

The reservoir area is used as a YMCA day camp and there are several docks located on the shoreline. There would probably be no damage to these owing to a rise of the water level within the surcharge space of the reservoir; however the access road to the dam would certainly be flooded.

e. Downstream Channel. The unnamed brook below Sprague Upper Reservoir empties into Sprague Lower Reservoir about 1/2 mile downstream. There are many homes along the shoreline of this lower reservoir. The dam at this lower reservoir has been breached and outflows from it would continue along the unnamed brook to the Stillwater River just west of the Route 116 river crossing. Eight homes and several commercial establishments are situated along the unnamed brook below the lower reservoir and the Stillwater River. The culvert carrying Route 116 over the Stillwater River is about 22 ft. long and 8 ft. high.

3.2 Evaluation

The visual inspection has adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam and appurtenant

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Sprague Upper Reservoir Dam took place on 3 April 1979. The reservoir was at about elevation 321 ft. There was leakage through the 16 in. dia. outlet pipe (about 10 gpm) and through the outlet culvert headwall and adjacent stone wall face(estimated to be about 300 to 400 gpm). The dam appeared to be in very poor condition.

b. Dam. The Sprague Upper Reservoir Dam is an uncemented stone wall dam with an upstream earth fill. The crest length is about 252 ft.; the top width of the dam varies from about 15 feet at the abutments to 80 feet at the mid-span of the dam and the maximum height of the dam is about 25 feet. The batter of the downstream wall is about 1 horizontal to 8 vertical. The upstream slope of the earthfill dam is partly covered with small rock riprap. The slope appears to vary from about 2 horizontal to 1 vertical, to about 1 1/2 to 1. Brush growth has begun to intrude on this upstream slope, while at the crest of the stone wall many 3 in. to 6 in. dia. trees have become established (see Photo No. 1, Appendix C).

The masonry wall forming the downstream slope is primarily a dry wall. However, there are some mortared joints, particularly on the bottom 10 to 12 feet above the base of the dam. There is a pronounced bulge on the face of the stone wall. However, previous sketches and inspection reports indicate that this condition has existed for some time. The downstream face of the wall is partially covered with vegetation. (See Photo No. 2, Appendix C)

There is a small pothole or sinkhole, located at the center of the dam in line with the outlet pipe and gatehouse, or about 96 ft. left of the right abutment and 66 ft. right of the left abutment. It measures approximately 3 ft. in diameter and about 14 in. deep. Previous inspection reports have indicated that this condition has existed for several years. However, generally this condition was referred to as a slight depression. Discussions with the operator indicated that the sinkhole has appeared recently (see Photo Nos. 3 & 4, Appendix C).

Seepage was noted at the location of the outlet pipe for a distance of approximately 60 to 70 ft. to the right. The heaviest seepage occurred over the top of a poured low concrete wall over the outlet pipe, estimated at about 300 to 400 gpm. There is also minor seepage of about 3 to 5 gpm approximately 40 ft. left of the outlet pipe at the toe of the dam (See Photo Nos. 9 & 10).

c. Appurtenant Structures. The spillway is located 300 ft. north of the left abutment and consists of a natural channel through a solid bedrock gorge. The channel sides appear to be stable. This spillway is spanned by a small wooden bridge about 20 ft. long. The channel proceeds perpendicular to the

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No data on the design of the dam or appurtenances has been recovered and probably none exist. In the course of the inspection, measurements were taken and a sketch plan and profile layout of Sprague Upper Reservoir Dam and appurtenances has been prepared. These sketches are shown on Figure 1 in Appendix B.

2.2 Construction Data

No records or correspondence regarding construction have been found.

2.3 Operation Data

The dam is operated by the Greater Providence YMCA. There appear to be no formal records.

2.4 Evaluation Data

a. Availability. Since no engineering data is available, it is not possible to make an assessment of the safety of the embankment. The basis of the information presented in this report is principally the visual observations of the inspection team.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity. Not applicable.

e. Storage (acre-ft.)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3) Spillway crest pool El. 321.0 - 281

(4) Top of dam El. 324.21 - 368

(5) Test flood pool El. 325.6 - 416

f. Reservoir Surface (acres)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3) Spillway crest El. 321.0 - 23.4

(4) Top of dam El. 324.21 - 26.5

(5) Test flood pool El. 325.6 - 27.6

g. Dam

(1) Type - Uncemented stone wall with upstream earth fill

(2) Length - 252 ft.

(3) Height - 26 ft.

(4) Top width - Varies from about 15 ft. to 80 ft.

(5) Side slopes - Upstream from 2 horizontal to 1 vertical to 1 1/2:1
Downstream 1 horizontal to 8 vertical

(6) Zoning - Not applicable

(7) Impervious core - Not applicable

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

(10) Other - Nil

h. Diversion and Regulating Tunnel - None

i. Spillway

(1) Type - Natural rock gorge

(2) Length of weir - 3 ft. (±)

(3) Crest elevation - 321.0

(4) Gates - None

(5) Upstream channel - Natural rock gorge

(6) Downstream channel - Natural rock gorge

(7) General - Nil

j. Regulating Outlets

(1) Invert - 299.84

(2) Size - 2 ft. by 2.5 ft.

(3) Description - Stone box culvert through dam

(4) Control Mechanism - Gate valve in line in wet well at gatehouse, with control hoist.

(5) Other - A 16 in. dia. pipe emanates from a headwall constructed at the downstream end of the stone box culvert.

(3) Ungated Spillway Capacity at Top of Dam. The spillway at the reservoir is an ungated natural rock gorge. The total spillway capacity at top of dam, elevation 324.21 MSL, is 120 cfs.

(4) Ungated Spillway Capacity at Test Flood Elevation. The ungated spillway capacity is about 200 cfs at test flood elevation 325.6 MSL.

(5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

(6) Gated Spillway Capacity at Test Flood Elevation. Not applicable.

(7) Total Spillway Capacity at Test Flood Elevation. The total spillway capacity at the test flood elevation is the same as (4) above, 200 cfs at elevation 325.6 MSL.

(8) Total Project Discharge at Test Flood Elevation. The spillway is inadequate to handle the test flood and the dam would be overtopped by about 1.4 ft. at elevation 325.6 MSL. The total discharge through the spillway and over the dam would be about 1,120 cfs.

c. Elevations (Ft. above MSL)

(1) Streambed at centerline of dam - 299.84

(2) Maximum tailwater - Not computed

(3) Upstream invert of outlet culvert - 300.29

(4) Recreation Pool - Not applicable

(5) Full flood control pool - Not applicable

(6) Ungated spillway crest - 321.0

(7) Design surcharge (original design) - Unknown

(8) Top of dam - 324.21

(9) Test flood design surcharge - 325.6

d. Reservoir

(1) Length of maximum pool - 2,500 ft.

(2) Length of recreation pool - Not applicable

(3) Length of flood control pool - Not applicable

been classified as having a high hazard potential in accordance with the Recommended Guidelines for the Safety Inspection of Dams.

e. Ownership. The dam is owned by the Greater Providence YMCA, Providence, Rhode Island.

f. Operator. Mr. Cezar L. Ferreira, Asst. Program Director, Greater Providence YMCA, 160 Broad Street, Providence, Rhode Island, 02903. Telephone: (401) 456 - 0100.

g. Purpose of Dam. The dam impounds a lake used for recreational purposes.

h. Design and Construction History. It is not known by whom the dam was designed or constructed. A 1946 inspection report by the Rhode Island Department of Public Works, Division of Harbors and Rivers, states that between 1905 and 1910 the Woonasquatucket Reservoir Company took over ownership of the dam from a man named Donovan and at that time the pond was called "Upper Donovan". The inspection report also stated that there was a record of leaks in the dam going back several years to when a grist mill was operated at the site by Mr. Donovan. Hence, it is surmised that the dam was constructed around the turn of the century.

i. Normal Operating Procedure. As the outlet gate is inoperative, there are no normal operating procedures for release of water. The dam is maintained by the Greater Providence YMCA. Trees, brush and debris are removed periodically.

1.3 Pertinent Data

a. Drainage Area. The drainage area contributing to the Sprague Upper Reservoir is situated at the headwater of an unnamed brook. The drainage area encompasses a total of about 0.5 sq. mi. (319 acres), of which 23 acres are occupied by the lake. The longest circuitous stream course contributing to the lake is about 4,600 ft. long with an elevation difference of about 54 ft., or at a slope of about 64 ft. per mile. The drainage area has a length of about 1.1 miles and a maximum width of about 0.67 miles, with an average width of about 0.6 miles. The basin consists of both open fields and forested areas, with sparse population.

b. Discharge at Damsite.

(1) Outlet works conduit. Discharge from Sprague Upper Reservoir is provided by a 16 in. dia. outlet pipe which has been installed in the downstream end of a 2 ft. by 2.5 ft. stone box culvert. The invert of the outlet culvert at the dam is at elevation 299.84 MSL. Presently the outlet gate at the upstream end of the culvert is inoperative.

(2) Maximum Known Flood at Damsite. No records are available of flood inflows into Sprague Upper Reservoir, nor of spillway releases and surcharge heads during such inflows.

wall dam is about 2 ft. and the downstream face of the stone wall has a batter of 1 horizontal to 8 vertical. The slope of the upstream face of the stone wall could not be ascertained. The upstream face of the stone wall is covered with an earth fill which varies from about 15 ft. wide at the abutments to about 80 ft. wide at the mid-span of the dam. The upstream slope of the earth fill varies from 2 horizontal to 1 vertical, to about 1 1/2 to 1 and the slope is covered with small riprap.

(2) Spillway. The spillway for Sprague Upper Reservoir Dam is located about 300 ft. north of the dam and consists of a natural channel through a rock gorge. The channel floor is about 3.2 ft. below the crest of the dam, has a bottom width of 2.5 ft. and side slopes of 3 horizontal to 1 vertical on the left side and nearly 1 to 1 on the right side. The rock formation appears hard and competent and is not lined with concrete.

The spillway channel is carried roughly perpendicular to the dam axis for about 120 ft. into and through the abutment, and drops in elevation about 4.5 ft. At the end of the channel water flowing through the spillway cascades down a rock face to the valley floor below and then back to the unnamed brook. A wooden bridge is provided where the access roadway crosses the spillway channel.

(3) Outlets. The outlet for this project is located at mid-span of the dam, where a 12 ft. by 12 ft. gate house is located just upstream from the dam crest. A 2 ft. high by 2.5 ft. wide stone box culvert extends from the upstream face of the gate house to a concrete headwall at the toe of the downstream face. A 16 in. dia. pipe installed in the downstream end of the culvert provides the outlet for water flowing through the stone box culvert. A wooden plank vertical slide gate operated from a rod and handwheel regulates flows through the outlet. At the time of inspection this gate was not operative and it has not been operative for serveral years.

c. Size Classification. The Sprague Upper Reservoir Dam is about 26 ft. high, impounding a storage of 280 acre-ft. to spillway crest level and about 368 acre-ft. to top of dam. In accordance with size and capacity criteria promulgated in the Recommended Guidelines for Safety Inspection of Dams, the project is categorized in the small classification.

d. Hazard Classification. A breach failure of the dam at Sprague Upper Reservoir would release water down the unnamed brook leading to Sprague Lower Reservoir. It could be expected that a sudden release of water from Sprague Upper Reservoir would be stored in the lower reservoir with some flooding of shore side properties. However, inspection of Sprague Lower Reservoir Dam revealed that this dam is breached. A flood wave would therefore pass through this reservoir, continue down the unnamed brook to its confluence with Stillwater River. In this instance it would be expected that there would be danger of about eight homes being affected with a possibility of loss of more than a few lives and excessive economic loss. Two commercial establishments as well as the Route 116 crossing over the Stillwater River could also be affected. Consequently, Sprague Upper Reservoir Dam has

SECTION 7
ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Sprague Upper Reservoir Dam appears to be in very poor condition at the present time. The deficiencies revealed indicate that further investigations are required. The principal items of concern are the major seepage of 300 to 400 gpm emanating from the downstream face of the stone wall, the presence of a small sinkhole at the crest of the dam above the outlet culvert from the gatehouse, inadequate spillway capacity, and the lack of drawdown capability for emergency conditions and/or repairs and maintenance work.

There is also a considerable amount of brush growth on the upstream slope, as well as many 3 in. to 6 in. dia. trees along the top of the stone wall.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner within one year after receipt of the Phase I Inspection Report, except that the investigations of the sinkhole at the crest of the dam should be carried out within three months.

d. Need for Additional Investigation. Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner should retain the services of a competent registered professional engineer to make investigations and studies of the following items, and, if proved necessary, design appropriate remedial works:

(1) Make soils and foundation studies, and determine the cause of the sinkhole at the crest of the dam.

(2) Determine the cause of the seepage at the toe of the dam.

(3) Determine whether the dam should be raised and/or additional spillway capacity provided to prevent an overtopping of the dam.

(4) Determine whether the existing outlet culvert and slide gate are repairable and of adequate size for emergency evacuation of the reservoir.

(5) Determine whether the outlet culvert headwall requires repair.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

(1) Brush growth on the upstream slope of the earthfill should be removed and controlled on a regular basis.

(2) A program for removal of trees and their root systems from the top of the stone wall and filling with suitable backfill material should be adopted.

(3) Debris and overhanging trees should be removed from the spillway discharge channel.

(4) Seepage quantity and clarity in the outlet channel should be monitored on a monthly basis until its source is determined.

(5) A formal surveillance and flood warning plan should be developed, including continuous monitoring of the facility during heavy precipitation.

(6) Procedures for an annual periodic technical inspection of the dam, and appurtenant works should be instituted.

7.4 Alternatives

The only parctical alternative to those discussed in Para. 7.2 is to drain the reservoir and breach the dam.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Sprague Upper Reservoir Dam

DATE 3 April 1979

TIME 9:00 a.m.

WEATHER Cloudy, Cold - 40°

W.S. ELEV. 321.0 U.S. N/A DN.S.

PARTY:

1. Pasquale E. Corsetti	6.
2. Roger F. Berry	7.
3. Carl J. Hoffman	8.
4. William S. Zoino	9.
5.	10.

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Hydrologic	Roger F. Berry	
2. Hydraulic/Structures	Carl J. Hoffman	
3. Soils and Geology	William S. Zoino	
4. General Features	Pasquale E. Corsetti	
5.		
6.		
7.		
8.		
9.		
10.		

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam DATE 3 April 1979

PROJECT FEATURE Stonewall Dam NAME W. Zoino

DISCIPLINE Soils/Structures NAME C. Hoffman

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	324.21 MSL
Current Pool Elevation	321.0 MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	At mid-length, 3 ft. dia., 14" deep sinkhole, circumscribed by 8 ft. to 10 ft, 6" deep depression
Lateral Movement	
Vertical Alignment	Slight belly in stonewall face d/s at 2 locations
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Appears stable
Indications of Movement of Structural Items on Slopes	None evident
Trespassing on Slopes	Minor
Sloughing or Erosion of Slopes or Abutments	None evident
Rock Slope Protection - Riprap Failures	Upstream slope, irregular
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	2 seepage points at d/s toe of stone wall
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam DATE 3 April 1979

PROJECT FEATURE Gatehouse NAME C. Hoffman

DISCIPLINE Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair
Condition of Joints	
Spalling	Isolated areas
Visible Reinforcing	None
Rusting or Staining of Concrete	Minor
Any Seepage or Efflorescence	None
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	None evident
Cracks	Some minor
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	N/A
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam DATE 3 April 1979

PROJECT FEATURE Spillway NAME C. Hoffman

DISCIPLINE Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	N/A
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	
Channel	Natural channel over bedrock
Loose Rock or Trees Overhanging Channel	Yes
Condition of Discharge Channel	Cluttered with debris

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam	DATE 3 April 1979
PROJECT FEATURE Spillway	NAME C. Hoffman
DISCIPLINE Hydraulics	NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	Yes
Floor of Approach Channel	Natural rock
b. Weir and Training Walls	N/A
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	Yes
Floor of Channel	Natural rock
Other Obstructions	None visible

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam DATE 3 April 1979

PROJECT FEATURE Access Road Bridge NAME C. Hoffman

DISCIPLINE Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	
a. Superstructure	Wooden bridge, spanning natural rock spillway channel
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	Good
Secondary Bracing	
Deck	Wooden timbers
Drainage System	
Railings	Wooden
Expansion Joints	
Paint	Good condition
b. Abutment & Piers	N/A - founded on bedrock
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat and Backwall	

PERIODIC INSPECTION CHECKLIST

PROJECT Sprague Upper Reservoir Dam DATE 3 April 1979

PROJECT FEATURE ______ NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITIONS
Dike Embankment	N/A
Outlet Works-Intake Channel and Intake Structure	N/A
Outlet Works-Transition and Conduit	N/A

APPENDIX B

ENGINEERING DATA

NARRAGANSETT IMPROVEMENT COMPANY

223 ALLENS AVENUE, PROVIDENCE 3, R. I.

TELEPHONE DEXTER 1-0051

COMMERCIAL • INDUSTRIAL • RESIDENTIAL

PAVEMENTS

BITUMINOUS CONCRETE FOR SALE

CONSTRUCTION EQUIPMENT FOR HIRE

EVERSON

January 21, 1966

DOWNTOWN BRANCH PROV. YMCA
160 Broad Street
Providence, R. I.

Mr. Frank Nagy, Ex-Secretary

Dear Sir:

I have been asked by the Camp Committee to report to you our findings regarding repairs to the dam at the new Day Camp Center in Greenville: We have been unable to find any blueprints or records regarding construction or previous repairs, however in talking with Mr. Steere who worked on the dam when Brown owned it and after making a careful on site inspection we have the following recommendations:

The present gate and spillway seem to be tight. The majority of the leekage seems to be north of the existing gate. Attempts to stop these leaks by adding concrete to the water side of the dam have been partly effective. Attempts to stop up the pipe on the lower side of the dam only divert the water through the stones around the pipe. We have hearsay information that one time another spillway existed in the area where leaks seem to exist. To determine the conditions in this area and the methods necessary to stop the leaks an excavation approximately 50' by 20' by about 20' will be required. A crane will be necessary for this excavation because of the depth and the need to cast the dirt out of the area. If the leaks are all in the area of an old spillway repairs and backfill will be fairly easy and inexpensive. If not we should be able to determine how extensive the needed repairs will be. This exploratory excavation and backfill should be done at a period of low water and should cost not over $700.00.

Yours truly,

Kirke R. Everson Jr.

"ESTABLISHED IN 1893"

NARRAGANSETT IMPROVEMENT COMPANY

223 ALLENS AVENUE, PROVIDENCE 3, R. I.

TELEPHONE DExter 1-0051

COMMERCIAL • INDUSTRIAL • RESIDENTIAL

PAVEMENTS

BITUMINOUS CONCRETE FOR SALE

CONSTRUCTION EQUIPMENT FOR HIRE

PRESIDENT
KIRKE B. EVERSON

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Yours truly,

Kirke B. Everson

Kirke B. Everson Jr.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

GREENVILLE, R. I.

March 12, 1966

Mr. Gerald R. Rotz
Executive Director
Greater Providence YMCA
Providence, R. I.

Dear Mr. Rotz:

Following an inspection of the impoundment on the YMCA property in Smithfield on Thursday March 10, 1966 with Assistant State Conservationist Fairman S. Reward, Agricultural Engineer, Rodney F. Taylor and myself the following conclusions have been reached.

The leak in the present structure may be caused by one or more factors. It is our firm belief that a major repair program must be instituted to correct the situation properly and prevent a recurrence. We feel that the leak may be caused by either porous material such as space piped under pressure between stones and or boulders, piping resulting from decaying root systems from trees and plants on the dam or from a defective drain pipe.

We recommend that a reliable contractor with proper equipment be consulted on cost. He should have at his disposal equipment such as a clam shell, bulldozer, dump truck and loader.

The work should include removing all vegetation from the present dam, removing all the stones and porous concrete from the facing of the dam and finally excavating a core trench at least 10 to 12 feet wide for the full length of the dam and down into a firm original base. Extra care will be required in working in the area of the pipe.

If it is decided that the drain pipe system is adequate then backfilling with a good stone free impervious material well compacted could be done to complete the job. This material should be the full width of the core trench of 10 to 12 feet.

In calculating the requirements of a structure such as this to meet the state requirements we have the following figures.
The drainage area is 322 Acres with a 100 yr. frequency run off of 252 cubic feet per second. This figure adjusted to compensate for storage results in a discharge capacity of 151 cfs to be handled.
An emergency spillway 32 feet wide designed 1.5 deep would be needed.
The drop inlet structure or principle spillway required to handle 30% of this amount would have to be a concrete or cast iron conduit 21 inches in diameter with a riser box 2.5 x 2.5 ft..

I am enclosing a form used by the State for people requesting approval of plans involving construction or repair of dams. The state law is written on the back side of the form.

Sincerely yours,

Roger N. Leveque

December 10, 19[illegible].

Mr. Sloan,
Tillinghast, Collins and Tanner,
1015 Turks Head Building,
Providence, R. I.

Dear Sir:-

You have inquired of this office as to the safety of the dam at Upper Sprague Reservoir.

During the period of our recent inspections the water entering the pond has been passed via leaks in the dam. The pond level has remained practically constant at a height not much above the top of the draw-off opening.

The owner has recently removed the cover plate on the down-stream end of the draw-off pipe. This is an improvement to the extent that it avoids saturation of the embankment.

Before the pond could be maintained at a higher level, constructions on the pond side (to make the dam tight) would have to be installed and tested.

The representatives of the Reservoir Corporation have advised that they have no interest in a higher pond level.

You appreciate that it is not included within the authority of this office to compel those repairs to a dam which would be necessary if a full pond was maintained, when the owner, as in this case, does not maintain such a pond level, but rather accepts the responsibility of maintaining a low pond within the capacity of the embankment.

Yours very truly,

DIVISION HARBORS AND RIVERS

Frank W. O'Donnell, Chief.

c.c.
Mr. Holdsworth
Mr. Anderson
File

DIVISION OF HARBORS AND RIVERS

SURVEY OF DAMS IN RHODE ISLAND

Woonasquatucket River Basin #120 Sprague Upper

Drainage Area at the Dam 0.4 Sq. Mi.

February 1948

Spillway - The spillway is a ditch in rock cut which at full bank will have a sectional area of about 40 sq. feet. The roughness of the ditch makes it impossible to closely estimate its discharging capacity without a rating by current meter measurements. It is probable that the velocity of the water at full bank will be about 10 feet per second which results in a spillway capacity of 400 c.f.s.

The Draw-off is in bad order. The leakage in and around the Draw-off has recently kept the pond at a relatively low level even with the gate on Draw-off closed. This condition indicates that it is not safe to fill the pond.

Estimated extreme freshet 74 c.f.s.

[illegible]

In 1943 a retaining wall was placed at the end of the old culvert on the D. Stream face of the Dam and a [illegible] length of [illegible] R. [illegible] riveted pipe was laid thru wall and sealed with a removable plate at the end.

Old records supply information that a second culvert existed under this dam and ran from a point 20' to 30' North of present intake to intersect the present stone culvert at about the middle of the dam. This present culvert is made of field stone, laid dry, very porous & probably acts as a collecting gallery for leaks on pond side. A wooden gate (sliding in concrete headwall on pond side) is operated from a gate house (over concrete wall) above.

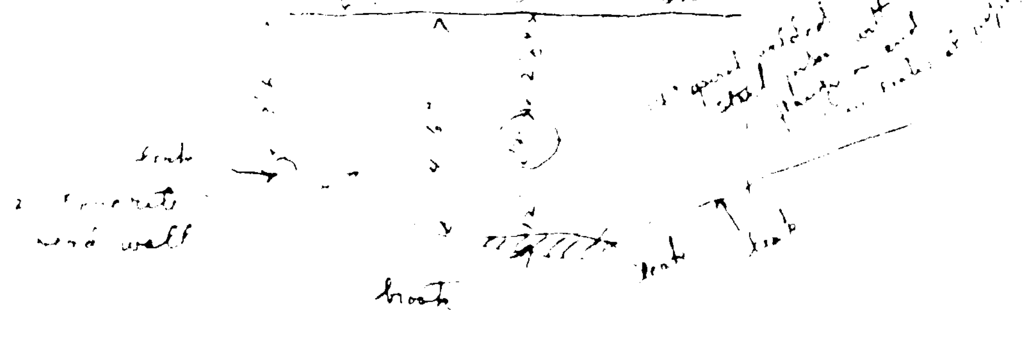
At the request of University officials the D. Str. face of the dam has been pointed up to a height of [illegible] above the base but, under full head, leaks occur around this tightened area, indicating that water rises within the dam until heights are reached at which it can escape.

The Woonasquatucket Reservoir Co. has no particular interest in maintaining this reservoir at the head of Sprague Brook because it has not used the draw off gate in past [illegible] years and has permitted Brown University to use all water needs without charge. It has never relinquished its title to water rights at this location.

The Reservoir Co. will permit Brown Univ. to make any repairs they deem desirable.

Recommendations (see separate sheet - typed)

Sketch - Concrete [illegible] wall at Culvert [illegible] (D. Str. face)



R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

DAM NO.

SPECIAL INSPECTION REPORT

INSPECTED BY

BROOK

NO. 126 NAME Sprague (upper) ON ~~RIVER~~ Sprague Brook WATERSHED Woon

OWNER Woonasquatucket Reservoir Co ~~STREAM~~

ADDRESS c/o Mr. Holdsworth, Pres. c/o Prov D B & C Co 21 Valley St, Prov RI Tel

REPORT ON NEW CONSTRUCTION REPAIRS INSPECTION ONLY ✓

PLANS BY APPROVED CONTRACTOR

INSPECTION REPORT BY J V Keely REASON Request by Mr. Sloan, B Univ DATE 10/23/46

TICKLER

SPILLWAY
TYPE
CONDITION
DRAW OFF GATES
NUMBER
CONDITION
BENCHES & WHEELS
EMBANKMENT
TYPE
CONDITION
APPROACHES
EROSION
BRUSHES & TREES
RIPRAP
PRESENT USE
HYDRO CONTROLS
WHO CONTACTED AT SITE
INSTRUCTIONS LEFT

Emergency Calls Res. 92 Ansdale Rd. Cranston

1. A.W. Anderson, Engr c/o Fid. & Casualty Co 511 Ind. Tr. Bldg. Tel Ga 9221
2. Henry A Fuller, Greenville (Snake Hill Rd Glocester) Scit 4316
3. Jos. Connette, Caretaker for Brown Univ (lives nearby) Ce 0754

Inspection Report

High earth dam in rocky gorge maximum ht - 30'±
A heavy masonry wall (batter 1 - 8) is on down-stream face with a slight bulge in centre over draw off pipe (10'± from top of dam varies from 15' to 30' wide at highest point of embankment. Medium sized trees to 4" diam on pond side. This face partly riprapped on 1-1½ and 1-2 slopes. No erosion on top or slopes.

Several leaks at bottom of wall around pipe on the face of Dam. Leaks are clear water apparently from around old draw off culvert. Date on masonry (Concrete) at Gate House - 1937.

Water in Reservoir is down 18' below top of dam at Gate House and 10-12 below normal level of pond filling small pond behind dam in day.

History

Mr A W Anderson furnished the following information:

When the Woonasq Res Co took over this property in 1905-10, there was a record of leaks in dam going back several years to a time that a grist mill was operated at this site by a man named Donovan and the pond was then called "Upper Donovan"

In 1931-32 Prof. Emerson of Brown Univ had a wall placed on the pond side (So. of Gate House) to stop the leaks. This wall did not stop all the leaks. (see over)

(margin:) Anderson not mentioned in Emergency Call
Holdsworth letter 12/9

FAUNCE HOUSE
BROWN UNIVERSITY
PROVIDENCE, R.I.

Office of the Director

Mr. Henry Ise -2- March [illegible], 19[illegible]

I believe it is true that Brown University does not control the riparian rights nor does it own the dam. The work that Brown University has done has not been to alter or in any way affect the structure of the dam.

Recently Brown University has put in a material below the water level on the bank of the dam called Bentonite which it is hoped will tend to reduce the leaking around the dam. Again this does not in any way affect the structure of the dam.

This work by Brown University has been done with the regular maintenance staff under the supervision of the Superintendent of Buildings and Grounds and it has been assumed this was for experimental and maintenance purposes and in no way was it for alterations or re-building of the dam.

We will be very glad to go into further detail concerning this matter if it appears necessary and I trust this has been an adequate explanation of the points raised in your letter.

Sincerely yours,

Nelson B. Jones, Director
Secretary of Brown Outing Reservation Board

NBJ/[illegible]
cc: Mr. Davenport

FAUNCE HOUSE
BROWN UNIVERSITY
PROVIDENCE, R.I.

DIVISION HARBORS & RIVERS

Office of the Director

March 2, 1950

Mr. Henry Isé, Chief
Division of Harbors & Rivers
Department of Public Works
State Office Building
Providence, 2, R.I.

Re: Upper Sprague Dam
(R.I.Dam No.120)
Smithfield, R.I.

Dear Mr. Isé:

Your letter of February 20th addressed to Mr. Davenport has been referred to me and Mr. Davenport regrets there has been a delay in sending it to me.

Although I had intended to answer your letter paragraph by paragraph I think now I had better treat it in a little different manner.

In 1946 Brown University discussed with the Woonasquatucket Reservoir Company, the owners of the Upper Sprague Dam, some matters concerning the repair of the dam. The Reservoir Company in August of 1946 stated substantially that they were unable to make repairs at the reservoir but the Board of Directors would "sanction the University to make such repairs as they may see fit to improve the boating and swimming facilities".

From that time until now the University has been unable to do anything about minor repairs. However on November 4, 1949 I wrote to Mr. A.W.Anderson, the Supervising Engineer for the company, describing the installation of a tile pipe stack in the sluiceway on the water side of the dam. This was to be installed so that if at any time such installation seemed undesirable it could be removed without affecting the dam in any way. Subsequently Mr. Anderson called me on November 14, 1949 to say that this work would be satisfactory and I acknowledged his conversation in my letter of November 15, 1949 expressing appreciation for giving us the opportunity to experiment with methods of improving the water level of the reservoir.

At the present time there is installed this stack of tile mentioned and on its top is inserted a grill through which water can flow if it reaches the height of the stack. Incidentally the height of the stack is well below the high-water mark for the reservoir. Beyond that I have been informed by our Superintendent of Buildings and Grounds that this installation in no way affects the structure of the dam for it is installed on the water side of the gate which has been closed, I believe, for some time.

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

DAM NO.

SPECIAL INSPECTION REPORT

INSPECTED BY [illegible]

TOWN - SMITHFIELD [redacted]

[illegible] NO. 2 NAME SPRAGUE UPPER RESERVOIR ON RIVER STILLWATER

WATERSHED [illegible]NASQUATUCKET

OWNER WO NASQUATUCKET RESERVOIR ASSOCIATION [redacted]

as below → 3/15/50

ADDRESS c/o ~~[illegible], PREST. c/o PROVIDENCE D. B. & C. CO. 52 VALLEY ST. PROVIDENCE,~~ TEL [illegible]

REPORT ON NEW CONSTRUCTION REPAIRS INSPECTION ONLY X

PLANS BY APPROVED CONTRACTOR

[illegible]KEEPER	INSPECTION REPORT BY JOHN V. KEILY REASON [illegible] ROUTINE DATE 3/13/48
	EMERGENCY:
	1. A.B. ANDERSON, ENGR., RES. 50 ANSDALE ROAD, CRANSTON, R.I. TEL WI 2023
	OFFICE % FIRE & CASUALTY CO., 511 IND. TR. CO. BLDG. GA 9220 (9-16A.M.)
SPILLWAY	2. HENRY A. FULLER, GREENVILLE, R.I. (SNAKE HILL ROAD) GLOCESTER) TEL. SCIT. 4316
TYPE	
CONDITION	
DRAW OFF GATES	3/13/47 CONDITION POOR
NUMBER	AFTER SPRING RAINS AND MOST OF SNOW OFF HILLS, POND HAS RISEN TO A POINT [illegible] BELOW BASE OF GATEHOUSE (WAS [illegible] BELOW ON 11/6/46 WITH [illegible] FLOW OUT OF PIPE.) TO-DAY GATE WAS APPARENTLY CLOSED, BUT LEAKAGE WAS 4" DEEP THROUGH PIPE [illegible] DOWNSTREAM FACE OF DAM. NO OTHER LEAKS IN EVIDENCE AROUND HEAD WALL. SOME ICE STILL IN POND. FLANGE OFF DRAW-OFF PIPE.
CONDITION	
BENCHES & WHEELS	11/26/47 11/26/47
EMBANKMENT	FLANGE ON DRAW-OFF PIPE HAS BEEN REPLACED ON DOWNSTREAM [illegible] GATE ON THIS PIPE IS CLOSED BUT LEAKS UNDER PIPE (UNDER CONCRETE FACING) IS ABOUT [illegible] DEEP. WATER IN POND IS TODAY ABOUT [illegible] FT. BELOW TOP OF CONCRETE BASE AT GATE HOUSE. [illegible] TAKE OFF FLANGE [illegible] REMOVED WITHIN 2 DAYS. POND PRACTICALLY DOWN.
TYPE	
CONDITION	
APPROACHES	
EROSION	[illegible] INSPECTION REPORT BY [illegible]
BRUSHES & TREES	[illegible] DRAWOFF PIPE [illegible] DOWNSTREAM AND [illegible] JUST BEEN FINISHED. [illegible]
RIPRAP	[illegible] GATE AND [illegible]
[illegible]	[illegible] APPARENTLY [illegible]
[illegible] CONTROLS	[illegible] PIPE WILL ACT AS AUTOMATIC WASTE [illegible]
	WILL BE [illegible]
WHO CONTACTED	[illegible] HARBORS & RIVERS [illegible] MAJOR CHANGES AT [illegible]
[illegible]	3/15/50 NEW PRESIDENT OF WOONASQUATUCKET RESERVOIR ASSOCIATION, PER J.V. KEILY MR. B.E. CORNELL MGR. ATLANTIC MILLS, 120 MANTON AVE., PROVIDENCE. SECRETARY & TREASURER DAVID C. HARDMAN % R PROVIDENCE D.B. & C. CO., 52 VALLEY ST., PROVIDENCE. MR. ANDERSON IS STILL ENGINEER FOR THE ~~XXXX~~ RESERVOIR ASSOCIATION.
DIRECTIONS LEFT	
IN EMERGENCY CALL	

July 7, 1967

TO: Mr. Henry Isé, Chief

FROM: C. F. Replinger

SUBJECT: Inspection of R.I. Dam No. 120, Upper Sprague Dam, Smithfield, R.I.

Pursuant to your instructions I investigated subject dam on July 5, 1967.

The Greenville Y.M.C.A. Outing Center is under the jurisdiction of Don Nelson, c/o Y.M.C.A. 160 Broad St., Providence, phone 331-9200. The phone at the camp is 231-9899.

Narragansett Improvement Co., 223 Allens Ave., Providence, phone 331-0051 (Kirke Everson) made temporary repairs to the dam by excavating near the gate house down to water level and found a leak which they stopped with a clay fill. This was considered as a temporary plug. Plans are in process by Everson for permanent repairs which are anticipated to be done in the fall.

At present the water in the reservoir is 2 ft. below the gate house floor. Very little water is on the downstream side of the dam, the level being approximately [illegible] ft. below the reservoir level.

A good flow of water is going over the spillway, approximately 535 ft. to the northwest of the gate house.

Byron Steere of Brown University has aided the Y.M.C.A. in its plans for repairs.

Application forms were left with Mr. Nelson.

C. F. Replinger

CFR:pc

Attached is a copy of a letter from Mr. [illegible], Secretary-Treasurer of the Woonasquatucket Reservoir Company, giving us permission to draw down the pond when necessary.

A new blueprint of the Gate House has been drawn. A copy will be sent to you as soon as completed.

Sincerely yours,

J. B. Rooney
Resident Engineer

JBR/ms
cc:
Mr. Cochran
Mr. Suprenant
Mr. Steere
Mr. Davenport

Enclosure

BROWN UNIVERSITY
PROVIDENCE 12, RHODE ISLAND

January 1[illegible], 1957

Mr. Henry Ise
Division of Harbors and Rivers
Department of Public Works
State Office Building
Providence 2, Rhode Island

Dear Mr. Ise:

In accordance with your wish, I am confirming in writing our discussion of the repairs made in and adjacent to the Gate House on the Upper Sprague Dam.

In a previous talk with you it had been indicated that a steel gate valve might be installed in place of the plank valve. On closer examination of the space available it was found impractical to accomplish this so the plank valve is still in use.

It was found the valve stem, made of wooden timbers, had rotted away. This was removed and replaced with two inch galvanized pipe.

The bottom of the Gate House was cleaned thoroughly of all matter restricting the drainage area. The plank gate was removed for inspection and found to be in very good condition. One more section, six inches deep, was added to ensure adequate depth to cover the sluiceway opening. The plank gate was replaced after cleaning the steel channels that act as guides. The same operating wheel and screw were reinstalled.

A large copper screen was installed over the intake stack. The intake stack has been reduced in height so that its inlet is approximately [illegible]' below the high water level for the pond.

All openings in the concrete apron on the north side of the Gate House have been caulked and concreted and this, in conjunction with the holes blocked in the earthen bank on the south side, has closed all the major leaks.

Additional gravel has been spread on the road and it is now possible to drive with considerable comfort to the Gate House, at which point a barricade has been erected to protect cars from running over the high embankment to the south.

PMJ

DEPARTMENT OF NATURAL RESOURCES

DAM INSPECTION REPORT

DAM: [illegible] RIVER: [illegible] Brook WATERSHED: [illegible] Stillwater

NAME: [illegible] Reservoir TOWN: Greenville-Smithfield

OWNER: Greater Providence Y.M.C.A.
[illegible] Street
Providence, RI [illegible]

Note: Mrs. Ferreira accompanied inspection. Mr. Ferreira disabled from recent knee operation. (Ass't Program Dir. for Shepard Reservation

REPORT ON:
General Condition of the Dam

REASON FOR INSPECTION:
Written Request by Mr. C. Ferreira [illegible]
N.I.D. [illegible] High/Small hazard

INSPECTION BY:

[illegible]
Carmine [illegible]

DATE OF INSPECTION:
April 21, 197[illegible]

REPORT: Existing Conditions:

Spillway - is a diversion ditch naturally formed through solid rock gorge.

Gate - Mrs. Ferreira stated that the draw-off gate is currently inoperable and has been "for some time" -- exact duration unknown. Outlet of culvert from gatehouse is partially blocked with debris, indicating it has not been used recently. Currently passing very little water--less than one gallon per minute. The gatehouse appears to be structurally sound and only shows minor spalling of concrete roof at the edges. (see photo 1)

Embankment - Stone faced (on downstream side) earthen embankment showing need of remedial action. Water is currently leaking through wall adjacent to opening of culvert (see photo 2). A review of the file has revealed a leaking condition of the embankment and attempts to repair it since 19[illegible], the latest attempt being in 1967. There is a visible dip in the roadway measuring about 8' X4' X 6" deep. Mrs. Ferreira stated this dip has been larger but has periodically been filled in. (see accompanying drawing)

Comments:

A letter to the owner (Providence YMCA) with a copy to the Woonasquatucket Reservoir Co., requesting the repairs to the gate mechanisms and embankment is suggested.

It seems logical that the gates be repaired first so that the water level of the reservoir can be lowered, if necessary. Secondly, it appears that the edge of the bank drops off very suddenly in the general vicinity of the leaking condition. This condition may be alleviated by the placement of riprap and clay-silt type fill. (I feel a thorough review and discussion is warranted before a letter is sent to the owner regarding this situation).

E.L.P.

Greater Providence Young Men's Christian Association

Oct. 11, 1966

Memo to: Whom it May Concern
From: Don Nelson, Frank Nagy, and Gerry Rotz
Re: Dam at the Greenville YMCA Outing Center

On a recent tour of the facilities at the Shepard Reservation in Greenville several conclusions were drawn concerning necessary steps to be taken on the dam repair project:

1. That Mr. Kirke Everson be encouraged to begin his exploratory project immediately; this project is one about which he has been previously contacted and has agreed to undertake for the approximate sum of $700. The hopeful outcome of the exploratory project is the finding of an apparent leakage in the core of the dam. This must be completed now.

2. With the knowledge gained from the exploratory project, the leakage area must be dredged out and the core of the dam repaired in whatever way is deemd feasible and necessary by Mr. Everson and the engineers. This project preferably to be completed in the fall of 1966.

3. The existing gatehouse which is not operable must be either repaired or renewed in order that the level of the lake may be maintained at the height desirable for day camp use. This part of the project to be completed as soon as possible.

There also has been constructed by the University, as a temporary expedient, a reinforced concrete box culvert out into the pond as an extension of the old stone culvert. Into the top of this culvert is connected a vertical overflow tile pipe riser. The upper end of this new culvert is closed. The apparent reason for its construction was to prevent leakage through the old wooden slide gate.

We are of the opinion that it will be worthwhile to attempt further repairs only after complete draw-down of the pond for a thorough examination of the dam and its foundations. We are also of the opinion that further attempts at blocking any leakage should be confined to only the upstream side of the dam for the reason that blocking the downstream face may even be dangerous by causing saturation of the earth fill and so reducing its stability.

If and when the pond is drawn down it will be advisable to measure the changing rate of outflow under the reducing head.

The suggestion has been made (as a temporary expedient for this summer) of pumping the leak at the downstream side of the dam up and over and into the pond. This would require a motor-driven pump in the order of 10-horsepower capacity which may have to be operated continuously during the dry season.

Needless to say, we would be glad to work with you on this entire problem if your interests so require.

Very truly yours,

CHARLES A MAGUIRE & ASSOCIATES

Wendell S. Brown

DOWNTOWN BRANCH
Greater Providence Young Men's Christian Association

Copy of a report from Charles A. Maguire & Associates on dam at Brown University Outing Center, Greenville, Rhode Island   Dated June 14, 1965

We are of the opinion that the question of satisfactory repair of the dam is a major undertaking involving considerable time and expense.

From what we can learn of the construction of the earth fill dam, there is no cut-off wall within it or under it, and it rests upon a ledge sloping downstream; and has a record of at least one failure, and a history of serious continuous leaking for the past several years.

At the present time, there is an old stone box culvert, approximately 2 feet high and 2 1/2 feet wide (probably with open joints), extending from the upstream face at the level of the bottom of the pond, sloping down to a discharge point on the downstream face approximately 28 feet below the top of the dam.

Along the lower or downstream face, a concrete headwall has been constructed within recent years, apparently to reduce leakage. This is penetrated by a 14-inch steel pipe laid in the bottom of the culvert and extending a few feet into it.

This pipe is now carrying most of the free flow of the dam which we estimate to be in the order of 200 gallons per minute. You have found by experience, stopping up the downstream end of this overflow pipe merely forces the water around the pipe and elsewhere around and under the bottom of the concrete wall above-mentioned. Apparently, therefore, the stone box culvert acts mostly as a free flow collection and discharge point for seepage through the earth dam.

At the upper end of this stone culvert, that is at the upstream face of the dam, there is a wood plank vertical slide gate operated from a rod and handwheel in a concrete gatehouse above. This may or may not be leaking but has been inoperative for so long as to make its attempted use dangerous from the point of view of being able to close it again.

Y61 - 5800

RECOMMENDATIONS

At the present time the leaks in the dam appear to be sufficient to pass all the water received in the pond.

The wall built south of the gatehouse on the pond side of the embankment is an effort made in the right direction to stop this leakage, but further study of the trouble should be made with the idea of devising means to make the dam tight by constructions on the pond face of the dam. Any work done on the down-stream face of the embankment to stop leakage results in saturating the embankment and if carried out to an extent which stops all the leakage, may produce a condition which may allow the material in the embankment to slide. A minor improvement to avoid high saturation of the embankment would be the removal of the plate at the end of the 16" spiral pipe in the old draw-off culvert.

It is advisable to do this immediately and no further wotk should be done in the down-stream face of the embankment for the purpose of stopping the leakage.

When work is contemplated for the purpose of stopping this leakage, plans should be submitted to this office for approval before any construction is started.

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS & RIVERS

SPECIAL INSPECTION REPORT

DATE: [illegible]

INSPECTED BY: [illegible]

DAM NO. [illegible] NAME [illegible]

TOWN OR CITY [illegible] ON [illegible] BROOK RIVER TRENCH WATERSHED

OWNER ADDRESS

REPORT ON

NEW CONSTRUCTION PLANS BY:

REPAIRS PERMIT GRANTED:

INSPECTION ONLY ✓ CONTRACTOR:

INSPECTION REPORT:

Water in [illegible] at [illegible] time [illegible] [illegible] below [illegible] reading [illegible] on [illegible] [illegible] was [illegible] [illegible] [illegible] water [illegible] [illegible] [illegible] as [illegible] observed (see sketch [illegible] [illegible]

[illegible] in [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] plate at [illegible]

[illegible] wall [illegible]

[illegible]

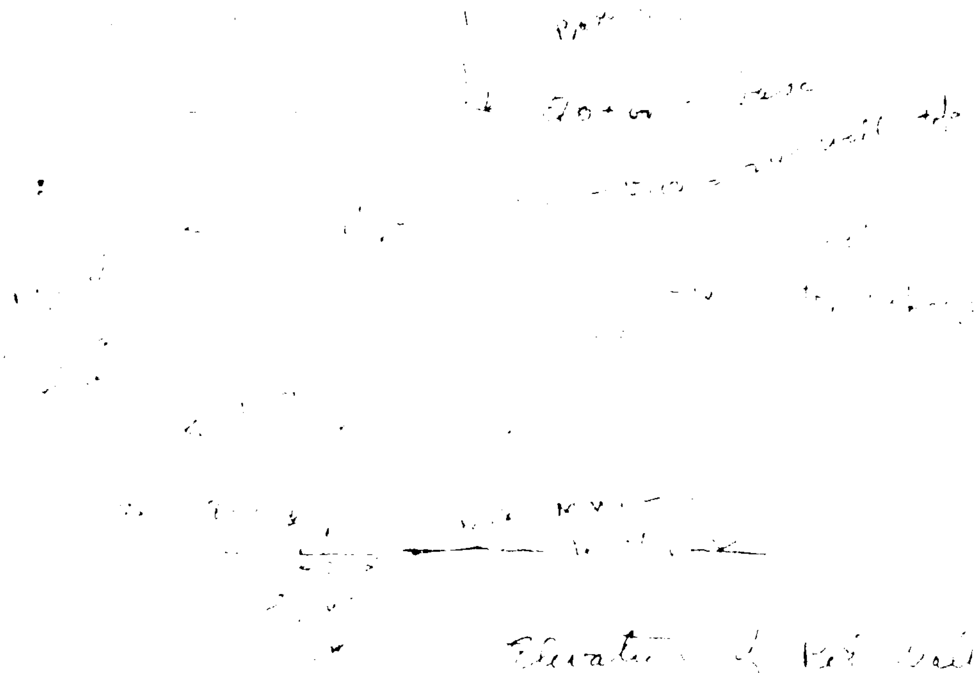
[illegible] wall [illegible]

[illegible] gate house [illegible]

Water flowing
to day at about
? gal per sec

to-day

SKETCHES OF SPECIAL CONDITIONS AT TIME OF INSPECTION:



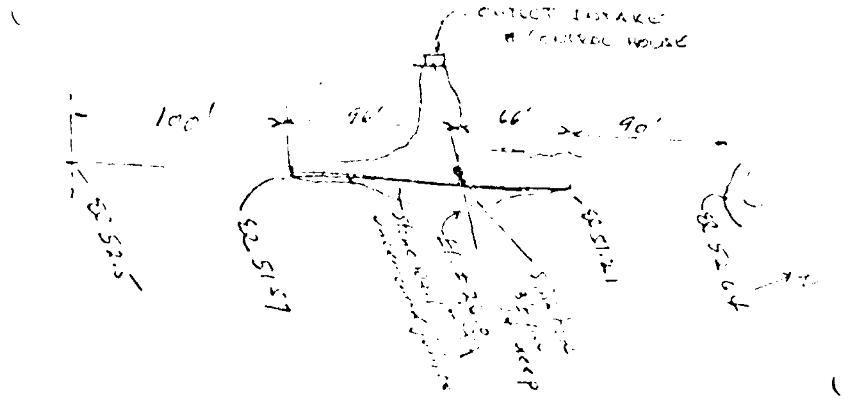
Elevation of ... looking East

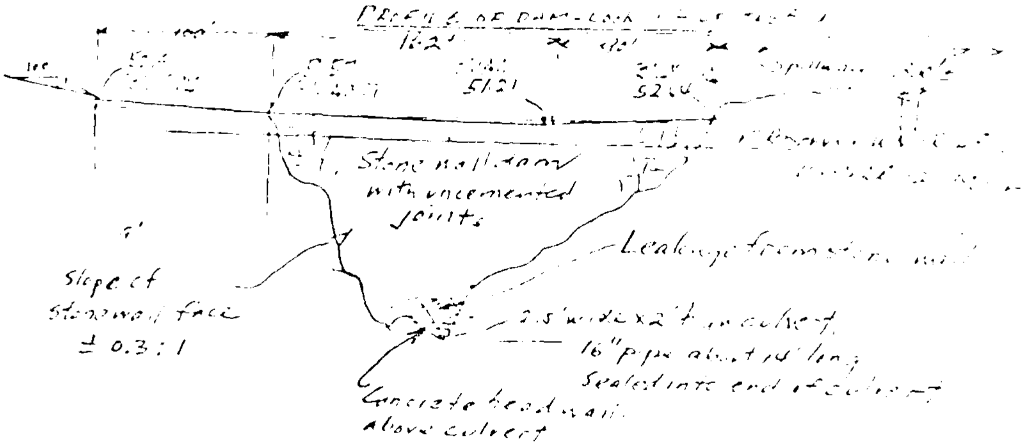
PREVIOUS REPORTS ON SAME PROJECT:

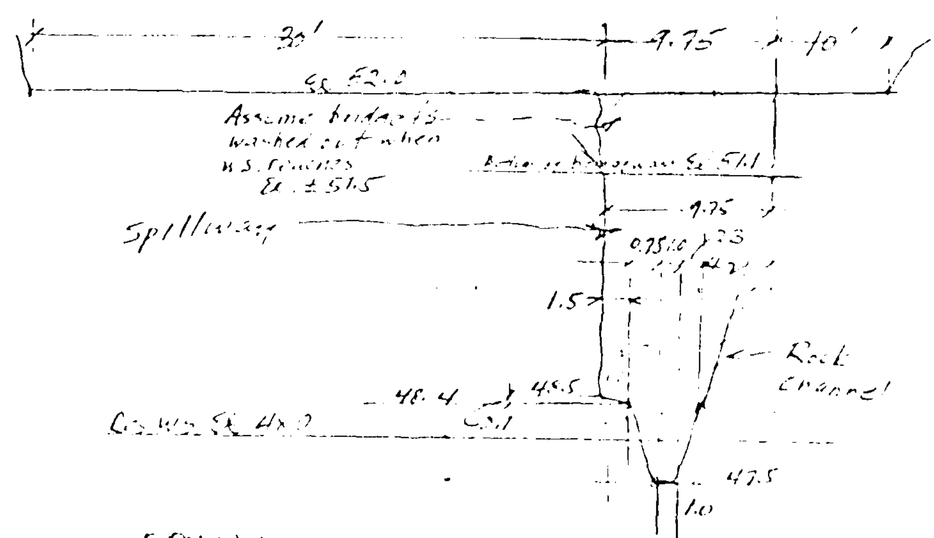
INSPECTED BY:

TITLE:

DATE:

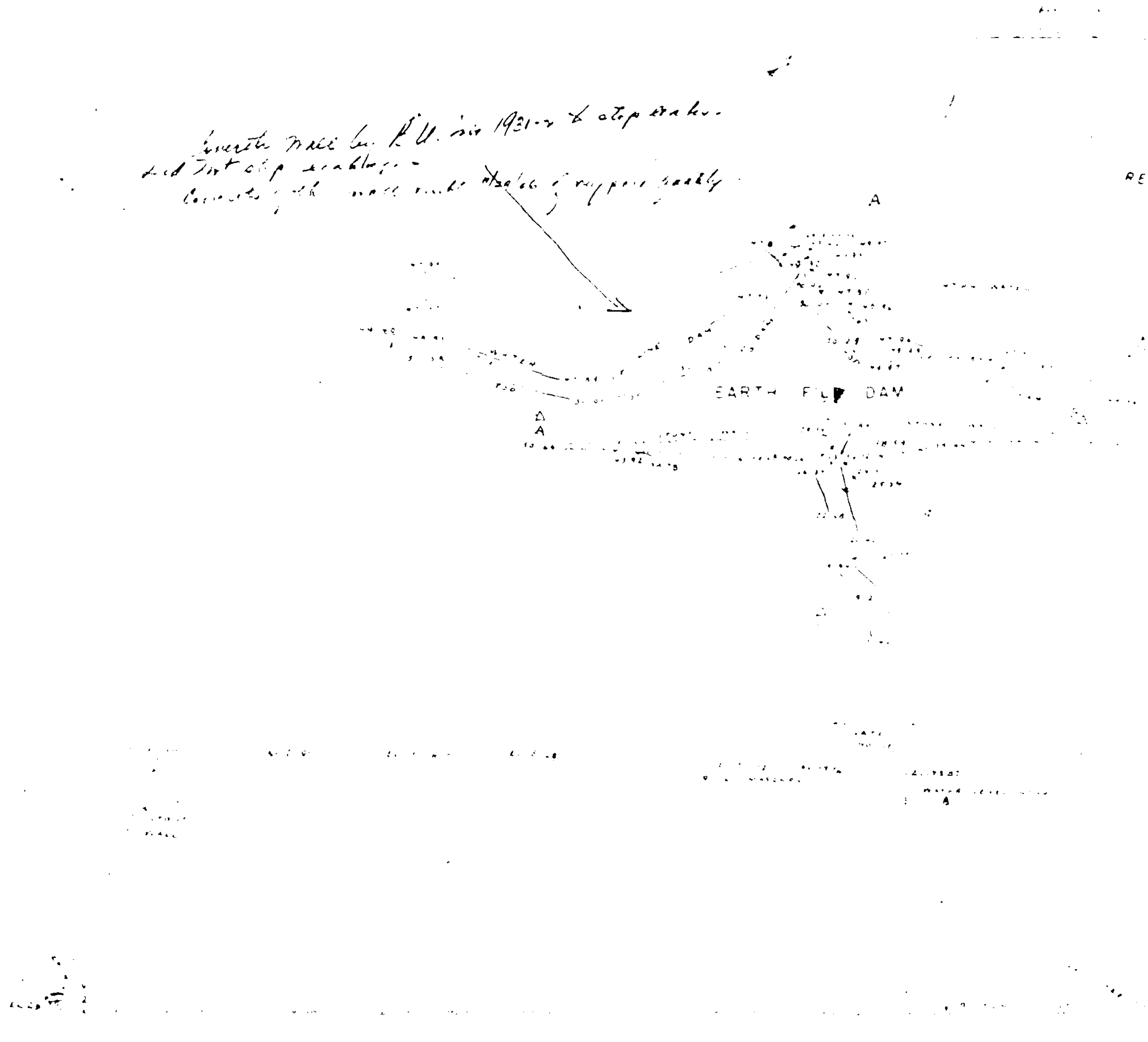




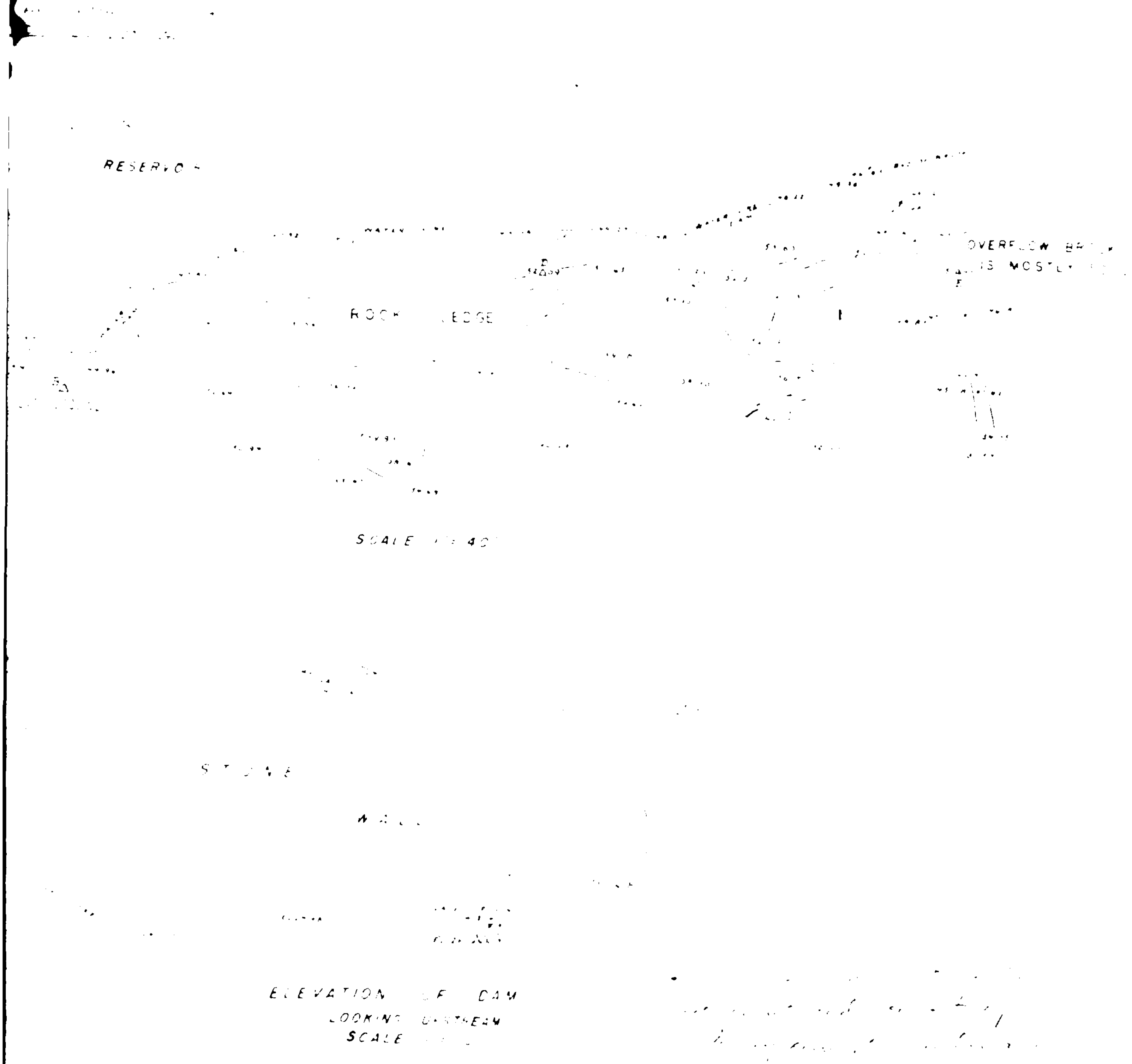


SPILLWAY SECTION

FIGURE 1



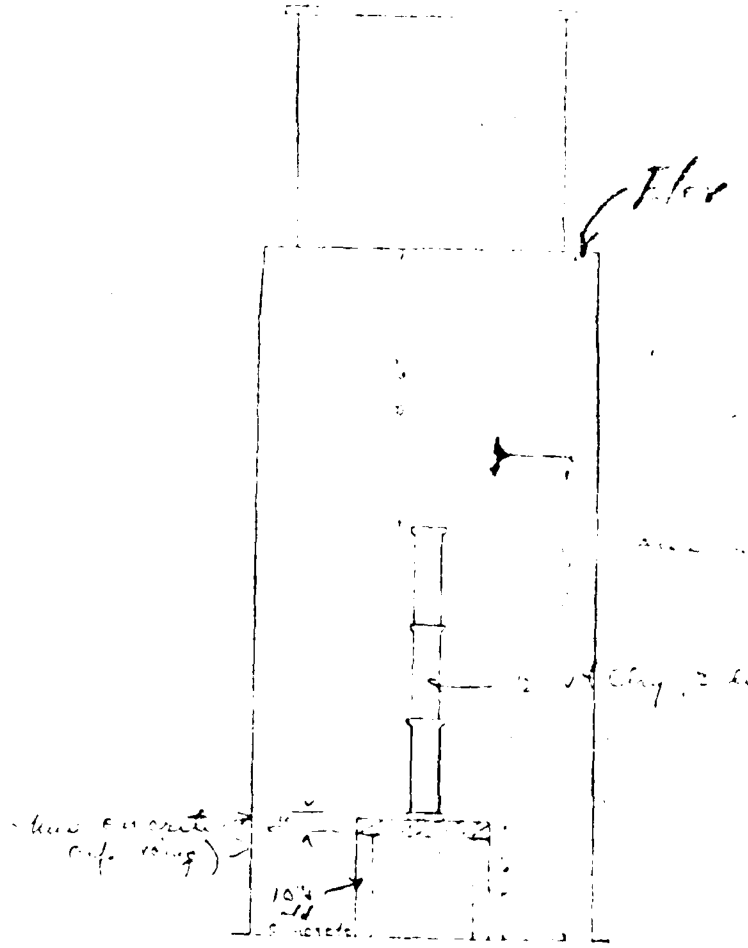
SECTION A - A
SCALE 1" = 10'

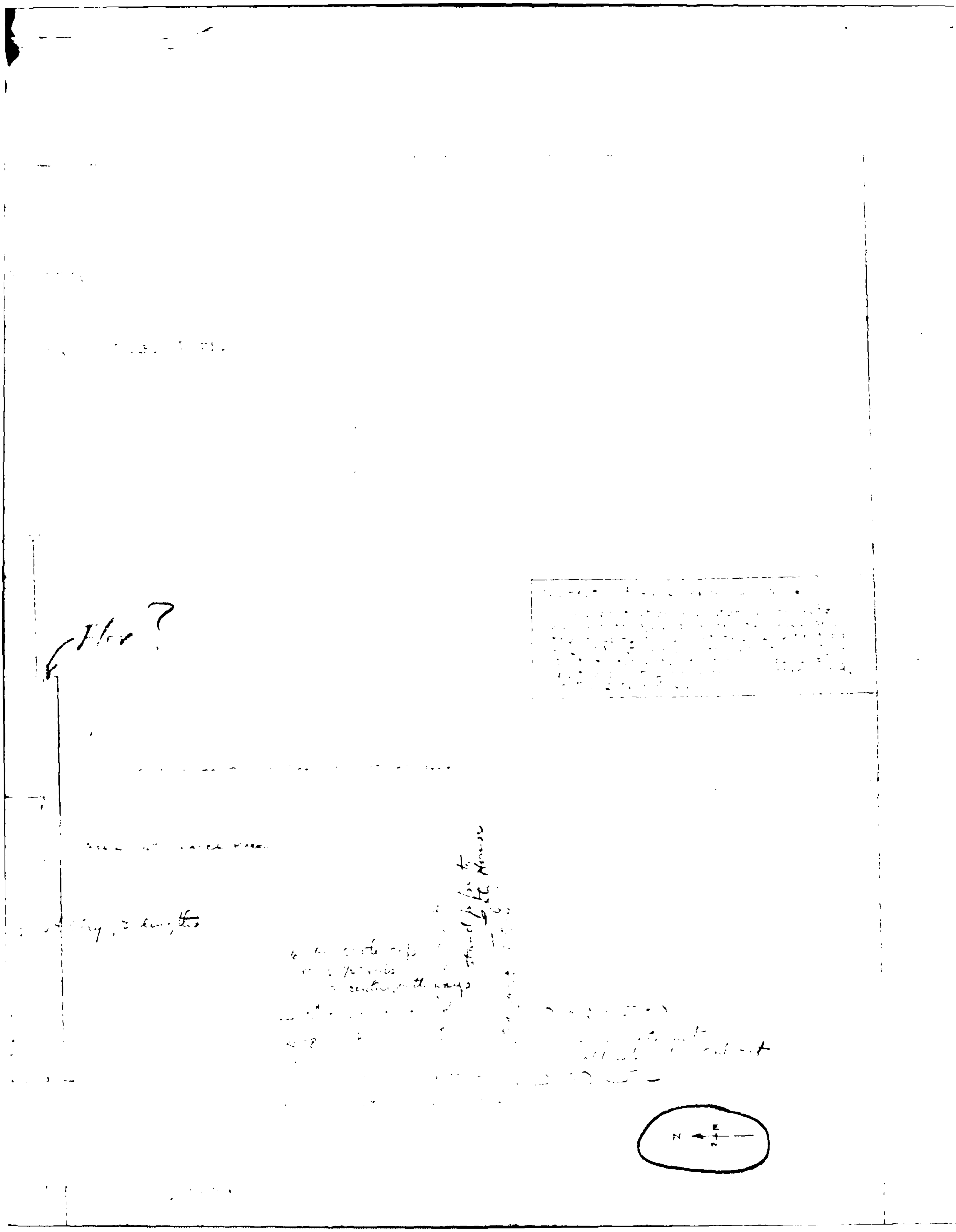


#120 ~~14~~ UPPER SPRA(

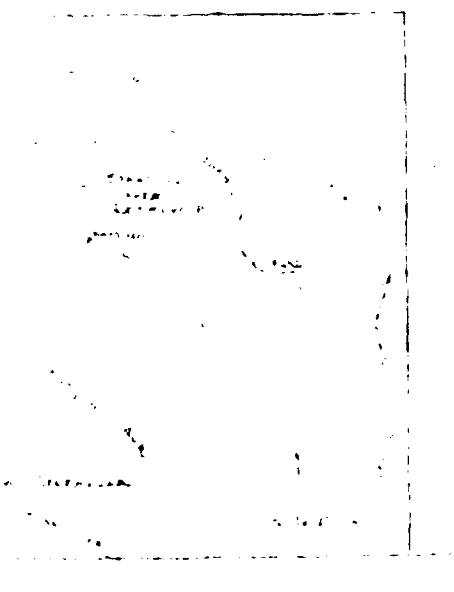
6-24-40 PLAN NO.

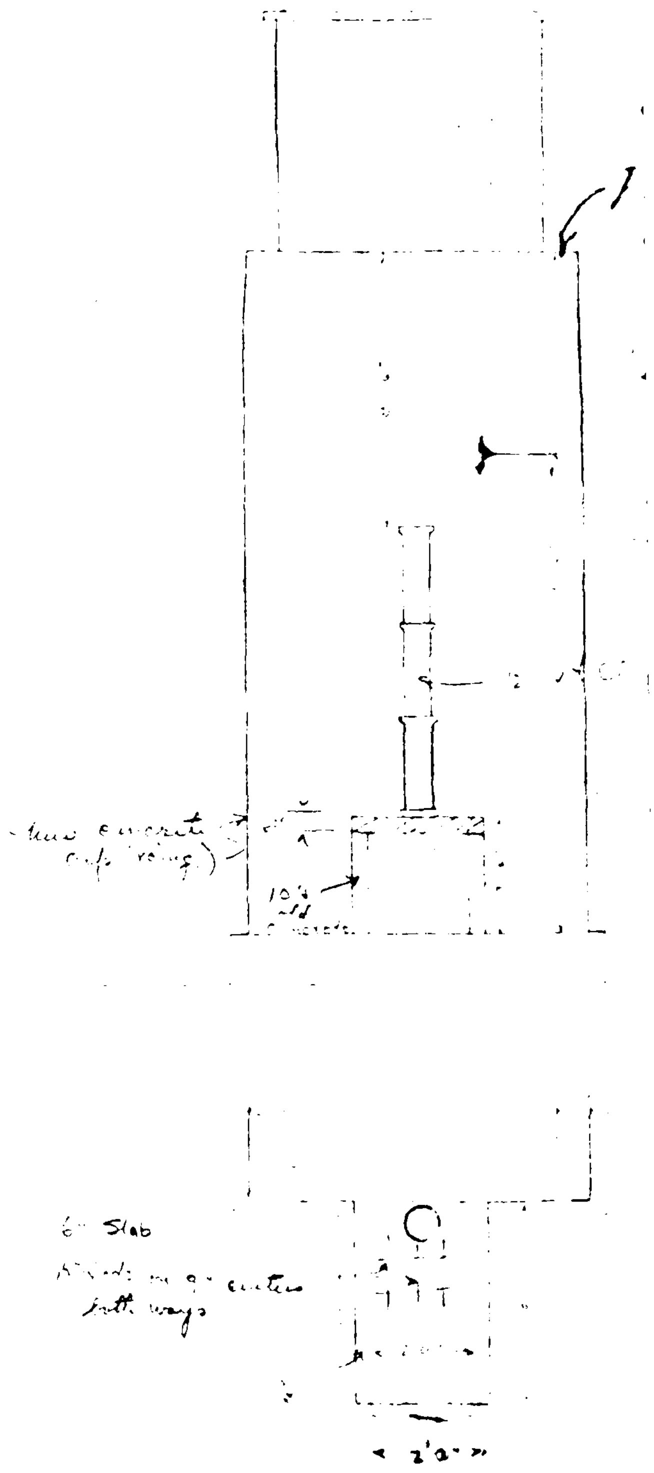
DAM

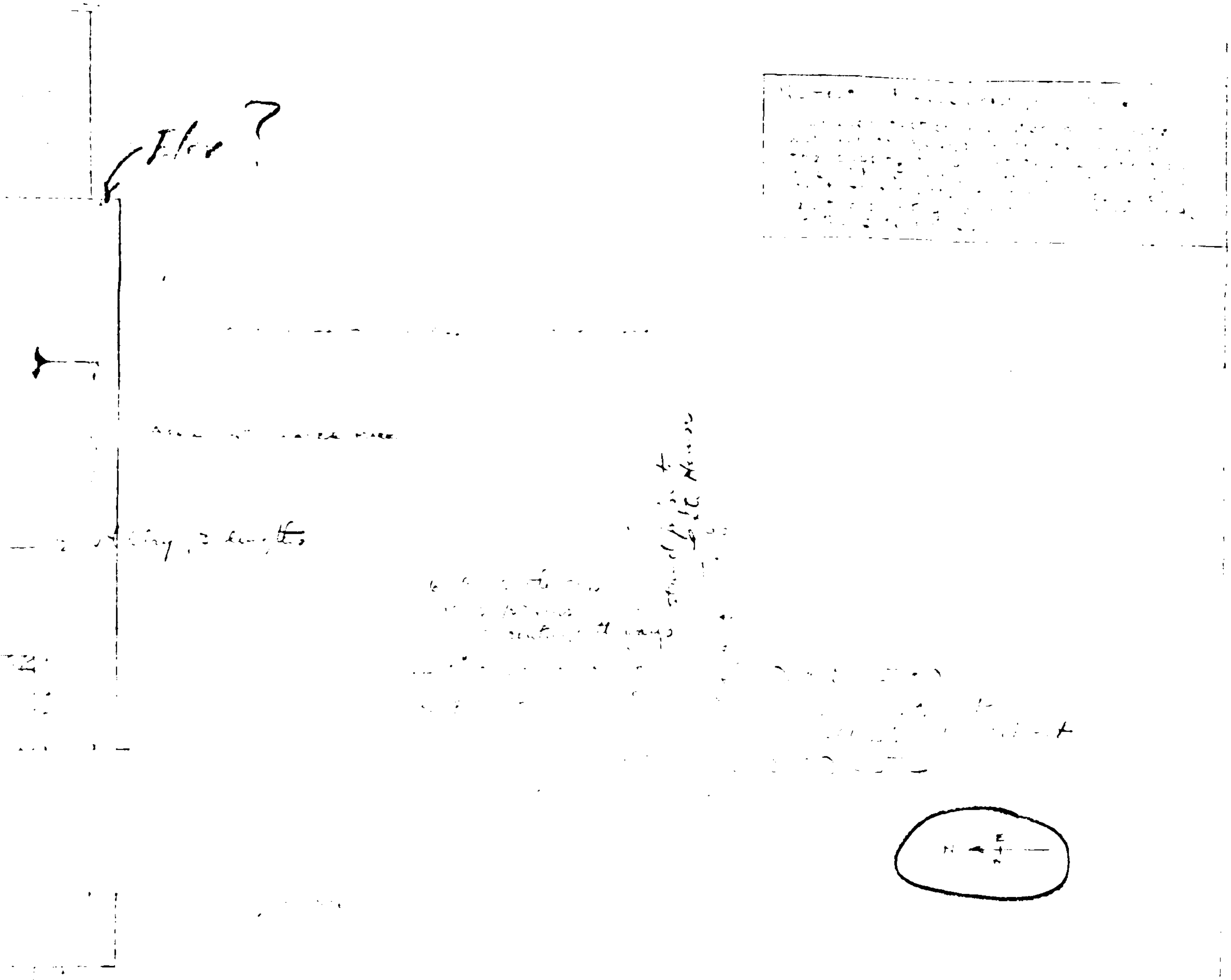




Here?
N
E
W

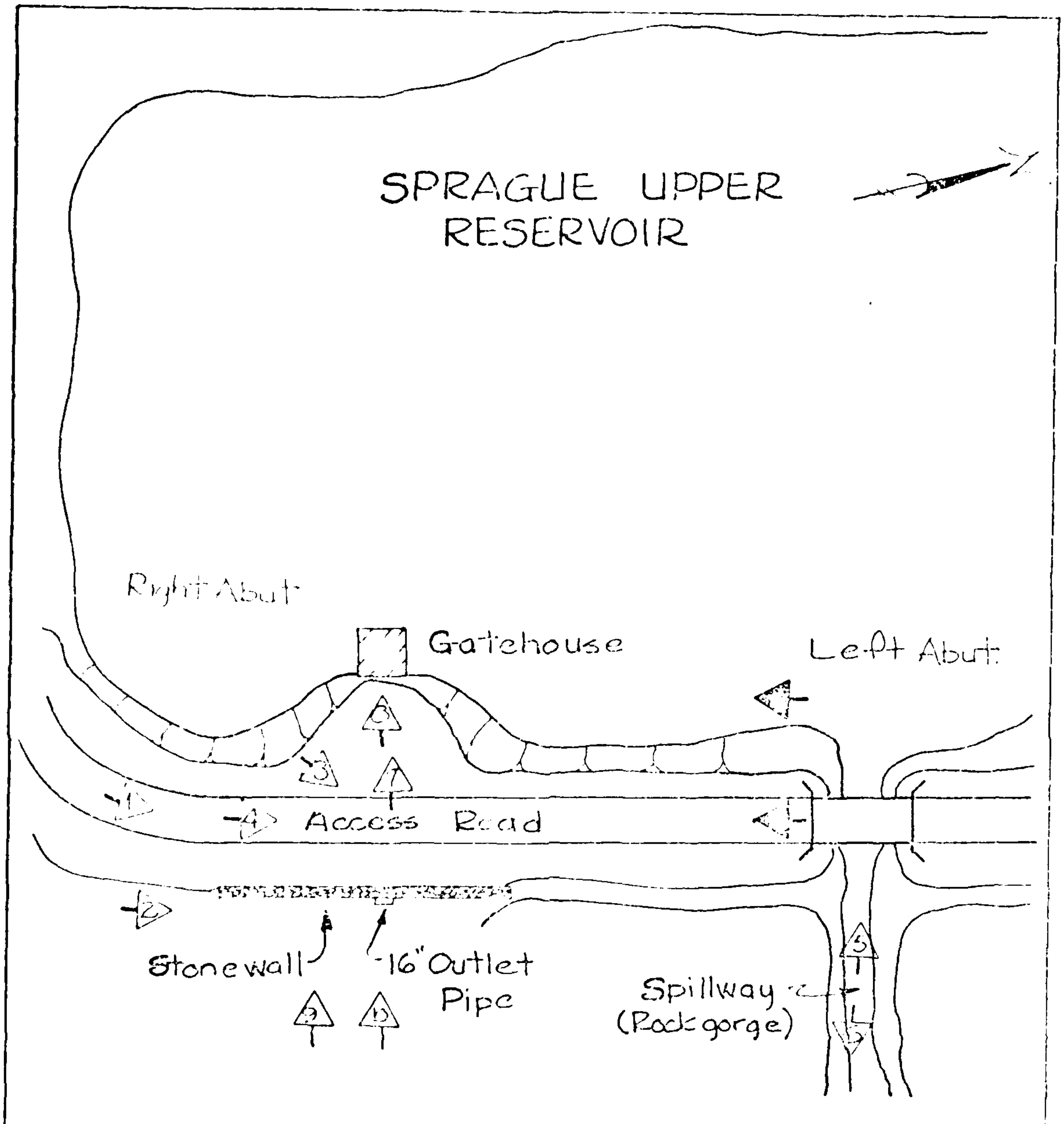



6" Slab
both ways
2'2"


Elev ?

APPENDIX C

PHOTOGRAPHS



Appendix "C" Photos

Overview Photos

[illegible]	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS [illegible]

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SPRAGUE UPPER RESERVOIR

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

STATE - R.I.

1. View from right abutment showing brush and tree growth on top of dam

2. Downstream face of stone wall

3. View of sinkhole at mid-length of dam crest.

4. View of sinkhole from right abutment.

BY [illegible] DATE 4/[illegible]/77 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO 9 OF

CHKD. BY DATE Dam Inspection Conn & RI PROJECT

SUBJECT Rating [illegible] for Upper Sprague over Top of Dam

@ Elev 325.5

$$Q = 2.9(80)(1.20)^{3/2} + 2.9(82)(1.02)^{3/2} + 2.9(60)(.65)^{3/2}$$
$$+ 2.9(40)(.19)^{3/2} + 2.9(40)(.81)^{3/2} + 2.9(48.8)(.33)^{3/2}$$

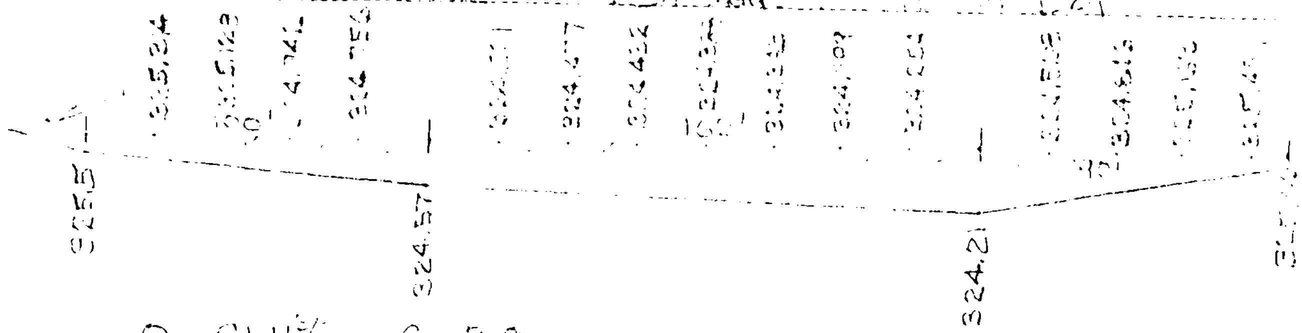
$$Q = 304.9 + 244.9 + 91.2 + 9.6 + 84.5 + 26.8$$

$$Q = 762 \text{ cfs}$$

@ Elev 325.0

$$Q = 2.9(80)(0.70)^{3/2} + 2.9(82)(.52)^{3/2} + 2.9(46)(.22)^{3/2}$$
$$+ 2.9(50)(.40)^{3/2} = 135.9 + 89.2 + 13.8 + 36.7$$

$$Q = 276 \text{ cfs}$$



$Q = CLH^{3/2} \quad C = 2.9$

@ Elev 324.57

$Q = 2.9(\,)\left[(.358)^{3/2} + (.294)^{3/2} + (.23)^{3/2} + (.124)^{3/2} + (.16)^{3/2} + \ldots + (.071)^{3/2}\right] + 2.9(\,)(.04)^{3/2} + 2.9(\,)(.01)^{3/2} + 2.9(3)(.001)^{3/2}$

$Q = 2.9(\,)\left[.196 + .157 + .124 + .042 + .064 + .042 + .01\right] + 2.9(\,)(.024) + 2.9(10)(.04) + 2.9(3)(.003)$

$Q = 2.9(\,)(.726) + 2.9(.07 + .001)$

$Q = 45.6 + .3 = 45.9$ cfs

@ Elev 326

$Q = 2.9(\,)\left[(1.788)^{3/2} + (\,)^{3/2} + (1.67)^{3/2} + (1.64)^{3/2} + (1.54)^{3/2} + (\,)^{3/2} + (\,)^{3/2} + 2.9(\,)(1.44)^{3/2} + (1.387)^{3/2} + (1.12)^{3/2} + (\,)^{3/2} + (\,)^{3/2} + (\,)^{3/2} + (.4)^{3/2} + (.1)^{3/2} + (1.6)^{3/2} + (1.12)^{3/2} + (\,)^{3/2} + (1.6)^{3/2}\right] + 2.9(10)(.4)^{3/2}$

$Q = 2.9(20)\left[2.35 + 2.36 + 2.18 + 2.09 + 2.00 + 1.9 + 1.84 + 1.62 + 1.22 + .95 + .61 + .46 + .25 + .02 + 2.06 + [illegible] + [illegible] + .74\right] + 111 + 8.5$

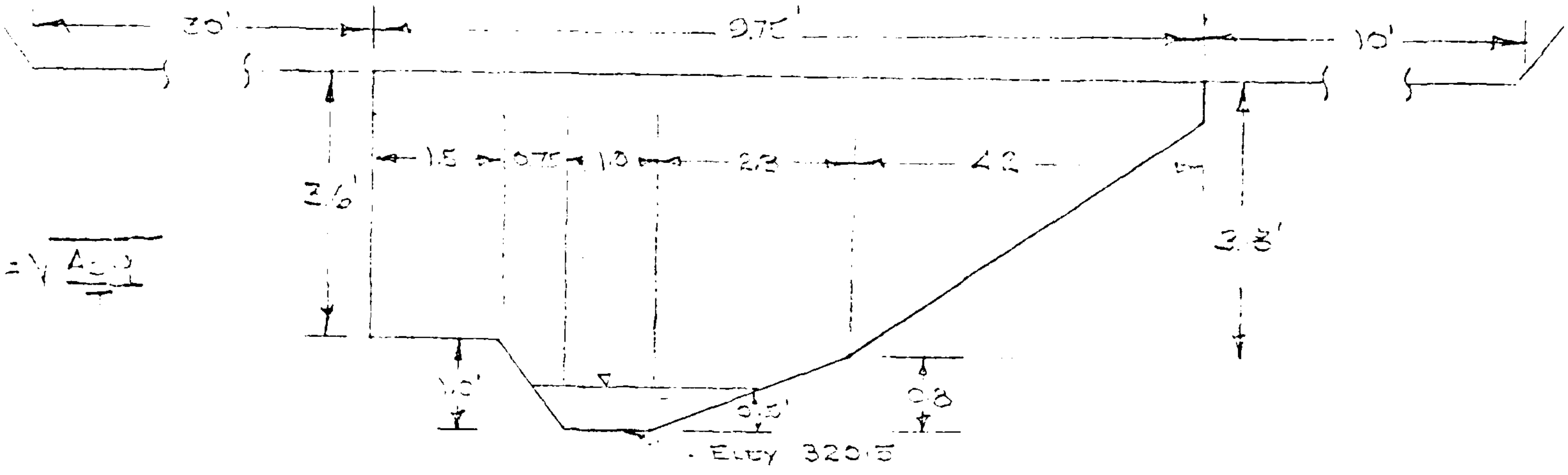
$Q = 58(24.92) + 119.5 = 1445 + 111$

= 1556 cfs

BY ______ DATE 7/__/__ **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 7 OF ___

CHKD. BY ______ DATE ______ PROJECT ______

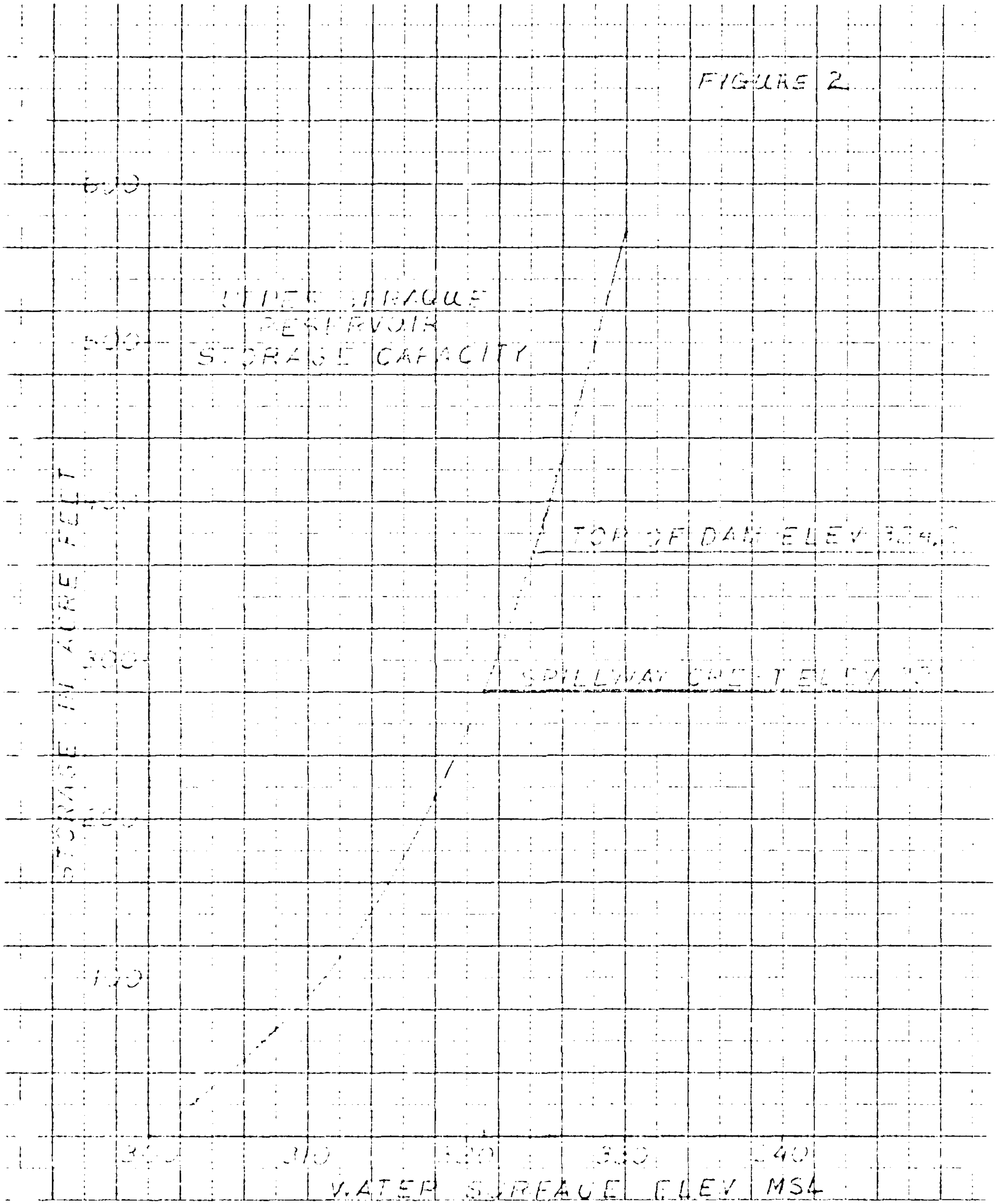
SUBJECT ______



$V_c = \sqrt{\frac{A g}{T}}$

Elev	Depth	Top Width	Area	Q cfs	V_c	h_{vc}	d + h_{vc}	Res W.S.
321	0.5	2.6	0.9	3.0	3.33	0.17	0.67	321.17
321.3	0.8	4.0	2.5	11.2	4.48	0.31	1.11	321.61
321.5	1.0	4.3	3.7	19.5	5.27	0.43	1.43	321.93
322.5	2.0	7.2	10.2	68.9	6.75	0.71	2.71	323.21
323.5	3.0	8.5	18.2	148.5	8.16	1.03	4.03	324.53
324.1	3.6	9.75	23.5	211	8.97	1.25	4.85	325.35
325.1	4.6	9.75	33.6	[illegible]	10.54	1.72	6.32	326.82
325.5	5.0	49.75	53.6	314	5.87	0.54		
326.5	6.0	49.75	103.6	845	8.15	1.04	7.04	327.54
327.5	7.0	49.75	153.1	1594	9.45	1.54	8.54	329.04

FIGURE 2


RESERVOIR
STORAGE CAPACITY
500
300
TOP OF DAM ELEV
SPILLWAY
STORAGE IN ACRE FEET
300
310
330
340
WATER SURFACE ELEV MSL

BY [illegible] DATE [illegible]

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 5 OF

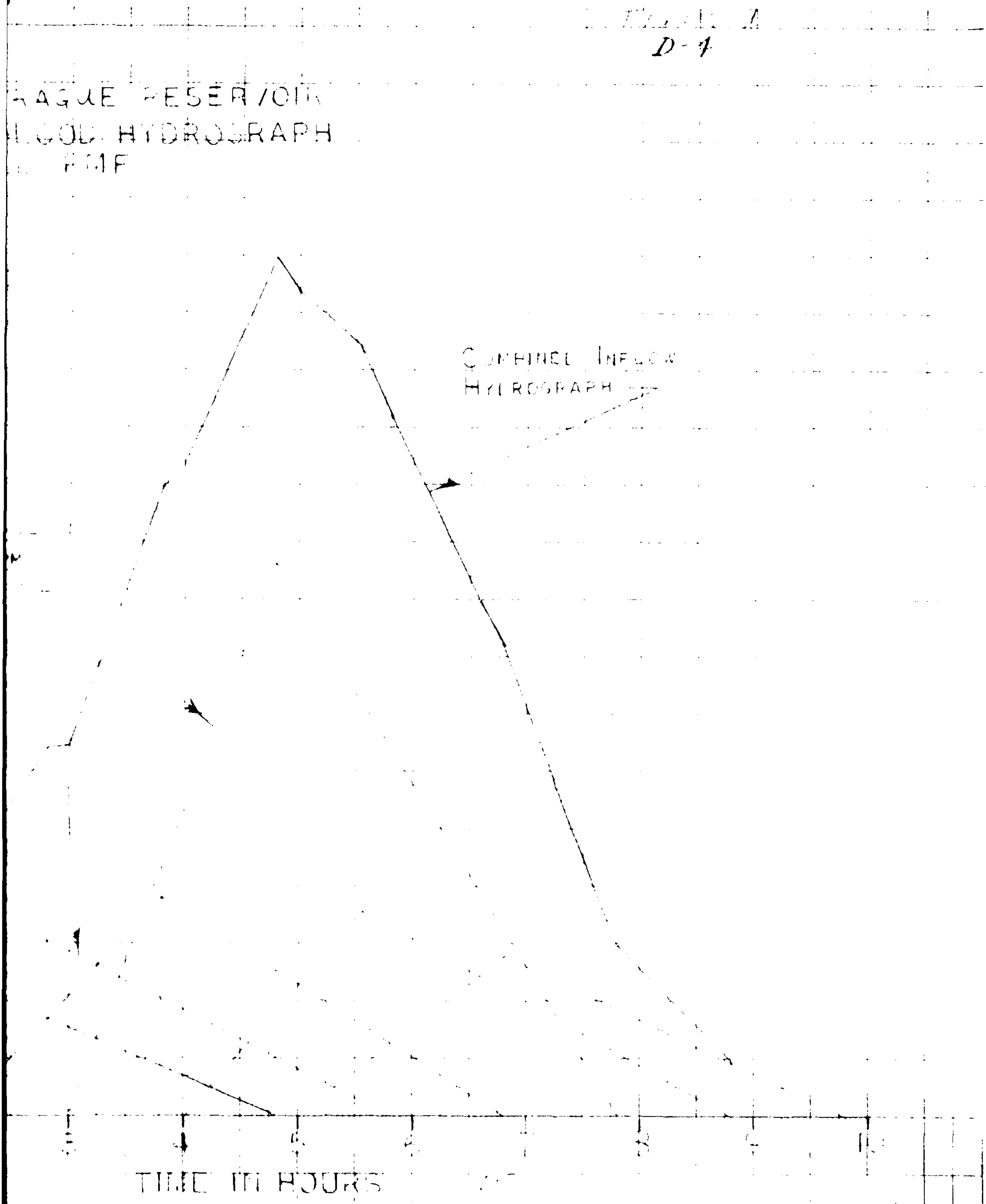
CHKD. BY ______ DATE ______ [illegible] RI

PROJECT ______

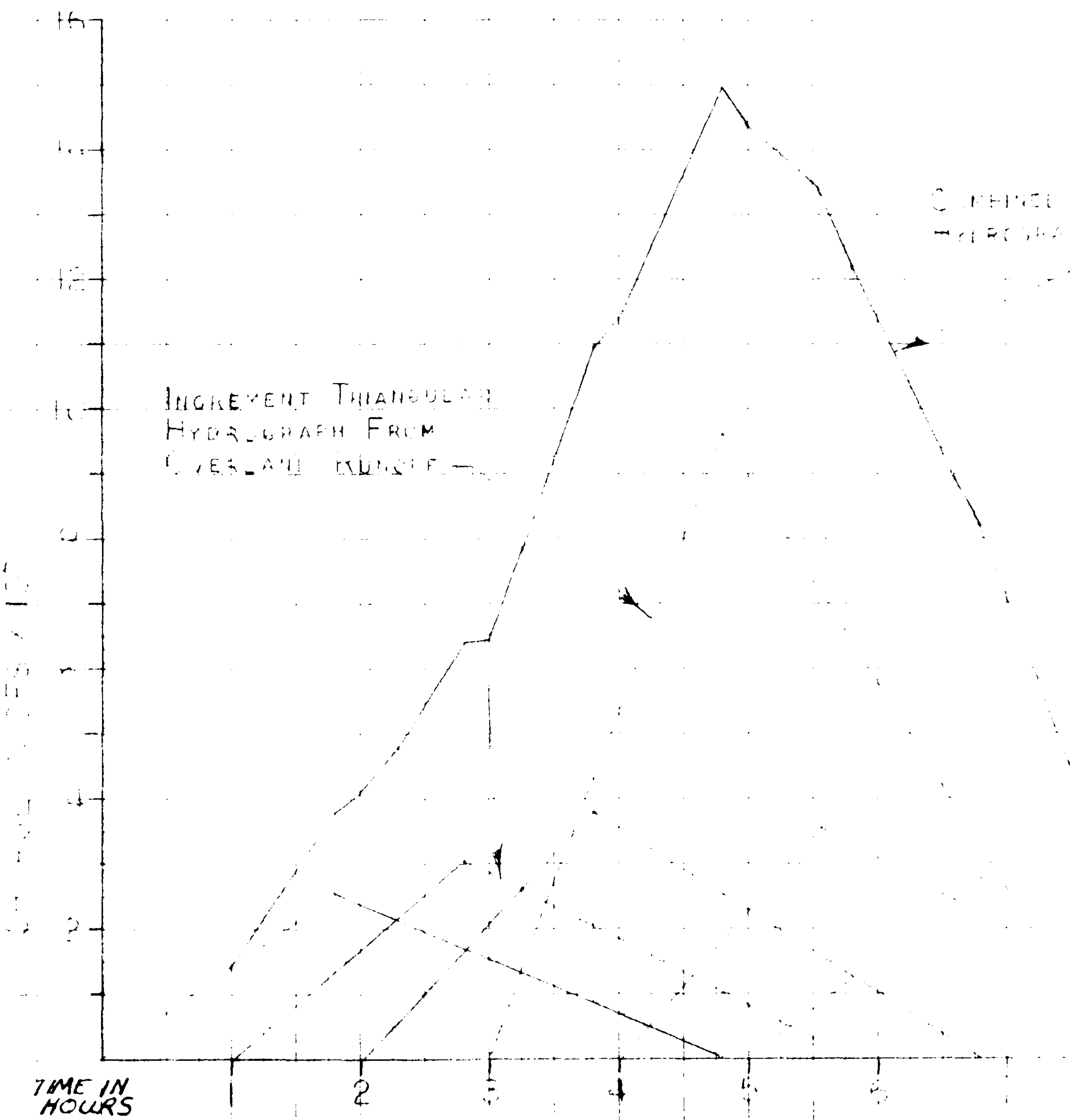
SUBJECT [illegible] AGUE [illegible] #9

COMPUTE VOLUME OF STORAGE IN RESERVOIR

ELEV IN FT	AREA IN ACRES	ΔH	ΔVOL ACRE FT	TOTAL VOL ACRE FT
300	6.6			
303	7.9	3	21.8	21.8
306	9.3	3	25.8	47.6
309	11.0	3	30.4	78.0
312	12.7	3	35.6	113.6
315	17.5	3	45.3	158.9
318	20.4	3	56.8	215.7
321	23.4	3	65.7	281.4
330	40.8	9	288.9	570.2


D-4
HYDROGRAPH
PMF
COMBINED INFLOW
HYDROGRAPH
TIME IN HOURS

UPPER SPRAGUE RESERVOIR
INFLOW FLOOD HYDROGRAPH
FULL PMF



TIME IN HOURS

BY RFH DATE 4/.../... **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 3 OF ...

CHKD. BY ...... DATE ...... PROJECT ......

SUBJECT ...... DAM #9

FLOOD HYDROGRAPH FOR PMF

TIME HOURS	RAINFALL %	RAINFALL INCHES	Q_p CFS.	BEGIN TIME	PEAK TIME	END TIME
0.0						
1.0	10	1.88	253	0	1.8	4.8
2.0	12	2.26	304	1.0	2.8	5.8
3.0	15	2.82	379	2.0	3.8	6.8
4.0	38	7.14	960	3.0	4.8	7.8
5.0	14	2.63	354	4.0	5.8	8.8
6.0	11	2.07	278	5.0	6.8	9.8
		18.80				

$$q = \frac{484(.5)Q}{1.8}$$

$$T_B = T_p + 1.67\,T_p$$

* Distribution of Maximum 6 Hour SPS or PMP in percent of 6 hour amount per EM 1110-2-1411

DRAINAGE AREA = 91.82 ACRES = 0.50 SQ MI
SPILLWAY CREST ELEV = 321 FT

COMPUTE Tp: 2 TRIBUTARIES TO RESERVOIR

1. L = 4600' H = 375 − 321 = 54' S = 0.012 S = 64 FT/MI

2. = 3400' = 425 − 321 = 104' = 0.031 = 164 FT/MI

AVE = 4000' = 0.76 MI AVE = 114 FT/MI

$$LAG = K\left[\frac{L \times L_{ca}}{\sqrt{S}}\right]^{.33} = K\left[\frac{.76 \times \frac{.76}{2}}{10.68}\right]^{.33} = 0.48\,K$$

USE CURVE "E": K = 2.5 TO 5.0, USE K = 4.0

LAG = 0.48K = 0.48 (4.0) = 1.92, SAY 1.90

1.22 Tp = LAG + D/2 SAY D = 0.5

$$Tp = \frac{1.9}{1.22} + \frac{0.5}{2(1.22)} = 1.56 + 0.21 = 1.77 \quad \text{SAY } 1.8$$

CHECK VELOCITY: V = 4000/3600 × 1.9 = 0.58 ≅ 0.6 FT/SEC OK

$$\text{FIND PEAK, } q_p = \frac{484\,AQ}{Tp} = \frac{484(.50)\,1}{1.8} = 134 \text{ CFS}$$

PMP = PROBABLE MAX PRECIP (6 HOUR)

= 24" (0.8) = 19.2" FOR R.I.

= 18.8" CONSIDERING INFILTRATION

[illegible] DATE [illegible]

LOUIS BERGER & ASSOCIATES INC.

HKD. BY [illegible] DATE [illegible] [illegible]

SUBJECT [illegible] RES. - [illegible] Area

SHEET NO. [illegible] OF

PROJECT

[illegible] ENTIRE AREA ABOVE DAM

PLANIMETER No. [illegible]
INDEX @ [illegible]
1 D = 1 sq in

[illegible]57	10.35
3.[illegible]	6.87
3.47	3.48

Ave Reading = 3.475 sq in
(Check Reading = 3.47 sq in)

$$(1'')^2 = (2000')^2 = \frac{40,000 \times 10^2}{43,560} = 91.83 \text{ ACRES}$$

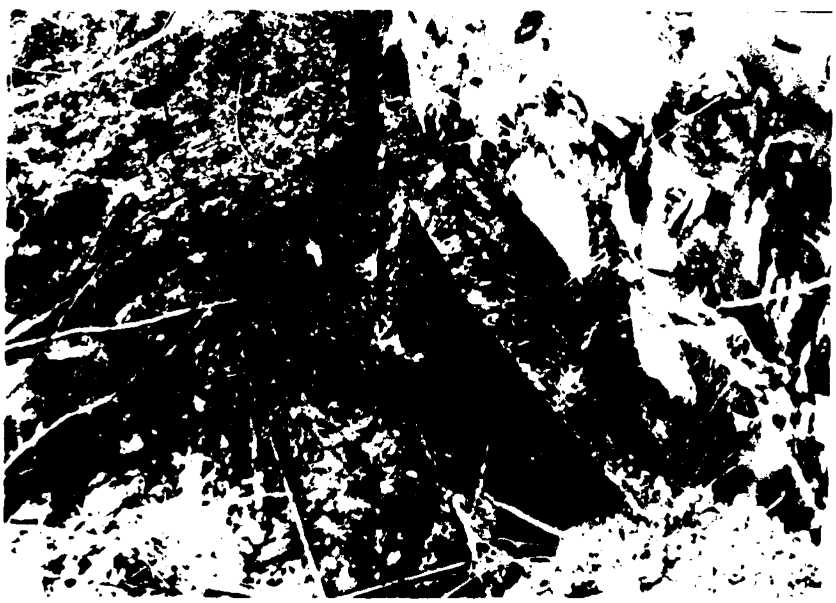
AREA = 3.475 x 91.83 = $\boxed{319.1 \text{ ACRES}}$

319.1 ÷ 640 ACRES/mi = $\boxed{0.50 \text{ sq mi}}$

APPENDIX D

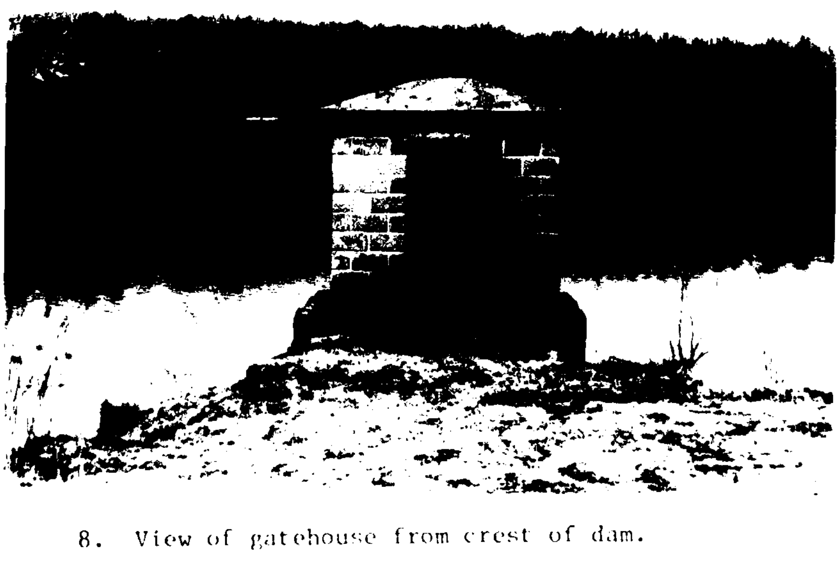
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

9. Seepage at outlet pipe & headwall

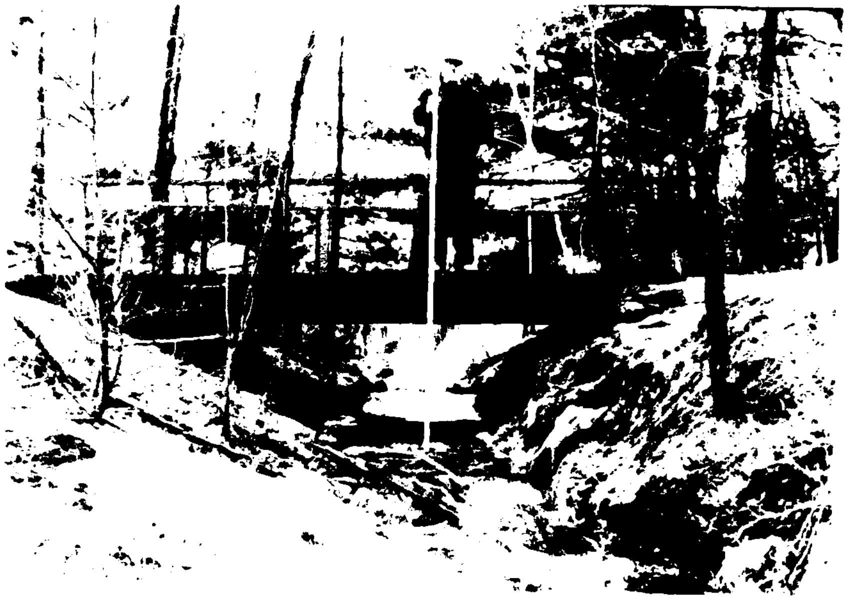


10. Seepage at outlet pipe & headwall

7. View of inoperable gate stem inside gatehouse.



8. View of gatehouse from crest of dam.



5. View of spillway channel from downstream.

6. View of downstream spillway channel.

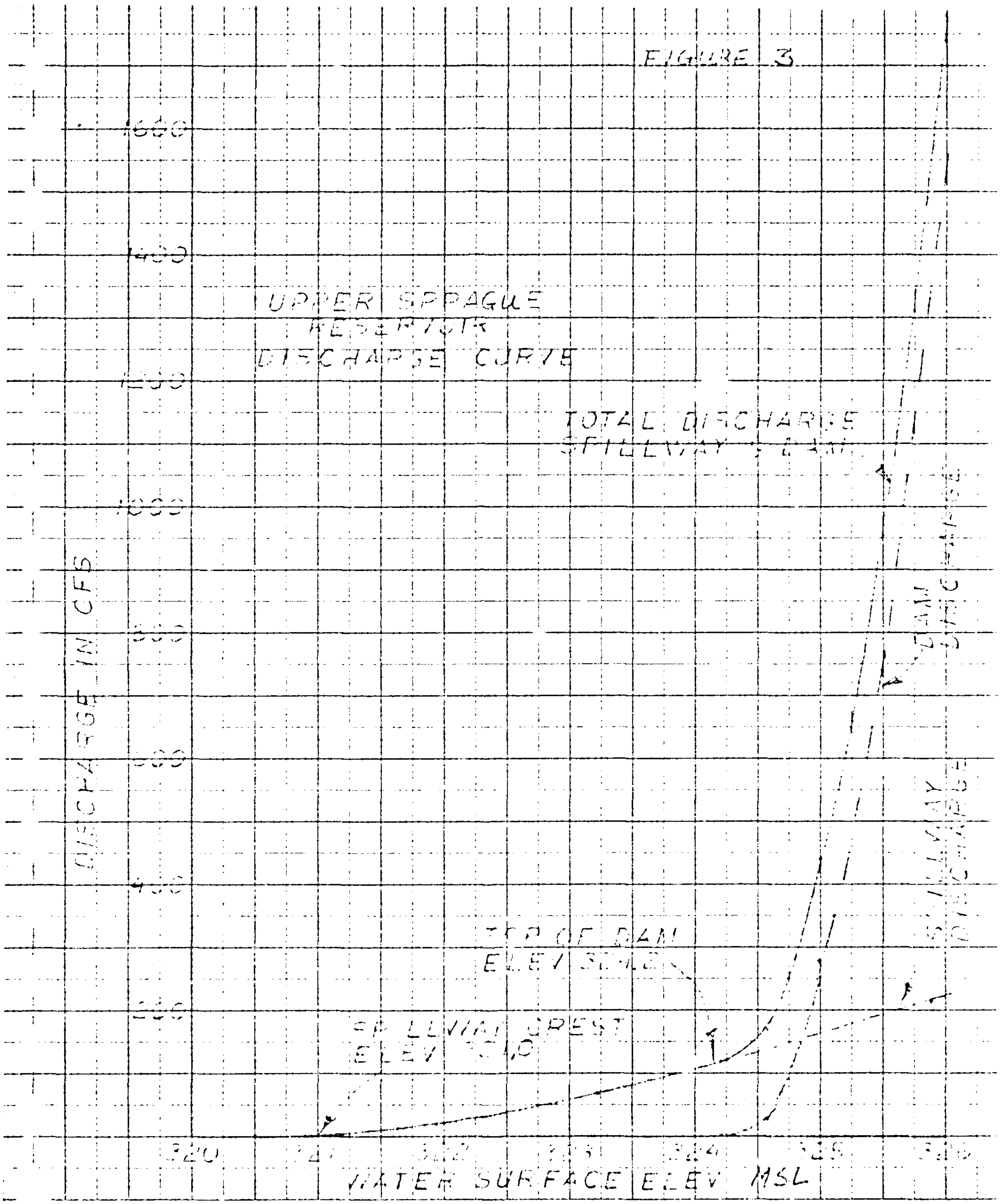


FIGURE 3
UPPER SPRAGUE
RESERVOIR
DISCHARGE CURVE
TOTAL DISCHARGE
SPILLWAY & DAM
DAM
DISCHARGE
SPILLWAY
DISCHARGE
TOP OF DAM
SPILLWAY CREST
DISCHARGE IN CFS
WATER SURFACE ELEV MSL
1600
1400
1000
400
320

D.A = 0.50 MI^2
SIZE CLASSIFICATION = SMALL
HAZARD CLASSIFICATION = HIGH
INSPECTION FLOOD = 1/2 PMF TO PMF

PICK OFF P.M.F FROM INFLOW HYDROGRAPH = 1490 CFS

STEP 1: PEAK INFLOW = 1490 CFS

STEP 2a: SURCHARGE HEIGHT, RATING CURVE = 325.25

STEP 2b: VOL OF SURCHARGE = 420 - 281 = 139 ACRE-FT

$$(1.39 \times 10^2 \text{ ACRE-FT})\ 4.356 \times 10^4 \frac{FT^3}{\text{ACRE-FT}} = 6.05 \times 10^6\ FT^3$$

$$(6.05 \times 10^6\ FT^3)\left(\frac{1}{.50 MI^2}\right) \times \frac{1 MI^2}{(5280)^2 FT^2} =$$

$$\frac{12.1 \times 10^6}{27.5784 \times 10^6} = 0.43\ FT = 0.43\ FT \times 12''/FT = 5.16 \text{ INCHES}$$

STEP 2c

$$Q_{P2} = Q_{P1} \times \left(1 - \frac{\text{STORAGE}}{19''}\right)$$

$$Q_{P2} = 1490 \times \left(1 - \frac{5.16''}{19''}\right) = 1490 \times (1 - 0.272)$$

$$Q_{P2} = 1084 \text{ CFS}$$

STEP 2 SURCHARGE HEIGHT FOR Q_{P2} = 325.5 FT

VOL OF SURCHARGE = 405 - 281 = 124 = $5.40 \times 10^6\ FT^3$

$$(5.40 \times 10^6\ FT^3)\left(\frac{1}{.50 MI^2}\right) \times \frac{1 MI^2}{(5280)^2 FT^2}$$

$$\frac{10.8 \times 10^6}{27.5784 \times 10^6} = 0.387\ FT = 4.65 \text{ INCHES OF [illegible]}$$

STEP 2b

STOR 1 = 5.16" RUNOFF

STOR 2 = 4.65" RUNOFF

AVERAGE = 4.90" RUNOFF = 0.41 FT

$0.41' \times \frac{0.53\,MI^2}{1} \times \frac{(5280)^2 FT^2}{1 MI^2} = 5.72 \times 10^6 FT^3$

$\frac{5.72 \times 10^6 FT^3}{4.356 \times 10^4 ACRE/FT^2} = 131$ ACRE FT 131 + 281 = 412

REFER TO STORAGE VS ELEVATION CURVE
412 ACRE FT READS ELEV = 325.6

REFER TO ELEV VS DISCHARGE CURVE

ELEV 325.6 = 1120 CFS

ELEV = 4.6 ABOVE SPILLWAY

SPILLWAY INADEQUATE TO HANDLE PMF
OVERTOPPING

CHECK WITH ½ PMF = 745 CFS

STEP 2b: SURCHARGE HEIGHT, RATING CURVE = 325.23

STEP 2c: VOL OF SURCHARGE = 408 - 281 = 127 ACRE FT

$(1.27 \times 10^2 \text{ ACRE FT}) \frac{4.356 \times 10^4 FT^2}{ACRE \cdot FT} = 5.53 \times 10^6 FT^3$

$(5.53 \times 10^6 FT^3) \frac{1}{1.25\,MI^2} \times \frac{1 MI^2}{(5280)^2 FT^2} =$

$\frac{11.06 \times 10^6}{27.8784 \times 10^6} = 0.38 FT = 4.59$ INCHES [illegible] RUNOFF

BY [illegible] DATE 4/11/[illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF 2
CHKD. BY ______ DATE ______ [illegible] PROJECT ______
SUBJECT [illegible]

STEP 2c

$$Q_{P2} = Q_{P1} \times \left(1 - \frac{STOR\ 1}{9.5''}\right)$$

$$Q_{P2} = 745 \times \left(1 - \frac{4.59}{9.5}\right) = 745 \times (1 - 0.483)$$

$Q_{P2} = 385$ CFS

STEP 3: SURCHARGE HEIGHT FOR Q_{P2} = 324.95

VOL OF SURCHARGE = 392 - 281 = 111 = 4.83×10^6 FT^3

$$(4.83 \times 10^6\ FT^3)\ \frac{1}{.50\ MI^2} \times \frac{1\ MI^2}{(5280)^2\ FT^2} =$$

$$\frac{9.66 \times 10^6}{27.878 \times 10^6} = 0.35\ FT = 4.24 \text{ INCHES OF RUNOFF}$$

STEP 3b STOR 1 = 4.59 " RUNOFF
STOR 2 = 4.24 " RUNOFF
AVE = 4.42 = 0.37 FT

$$0.37\ FT \times \frac{0.50\ MI^2}{1} \times \frac{(5280)^2\ FT^2}{MI^2} = 5.16 \times 10^6 = 118 \text{ ACRE-FT}$$

118 + 281 = 349

REFER TO STORAGE VS ELEV CURVE
399 ACRE-FT READS ELEV = 325.2

REFER TO ELEV VS DISCHARGE CURVE
ELEV. 325.2 = 610 CFS

ELEV. = 4.2 FT ABOVE SPILLWAY

SPILLWAY INADEQUATE TO HANDLE 1/2 PMF

BY RFB DATE 4/[illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. ____ OF ____

CHKD. BY ______ DATE ______ INSPECTION OF DAMS - [illegible] PROJECT ______

SUBJECT [illegible] HAZARD ANALYSIS - UPPER SPRAGUE RES.

STEP 1: USE TOP OF DAM AS POOL ELEV AT TIME OF FAILURE ∴ ELEV = 324.2

STORAGE AT TIME OF FAILURE = 364 ACRE·FT

STEP 2: $Q_{P1} = 8/27\, W_b \sqrt{g}\; Y_0^{3/2}$

$Q_{P1} = 1.68\, W_b Y_0^{3/2}$

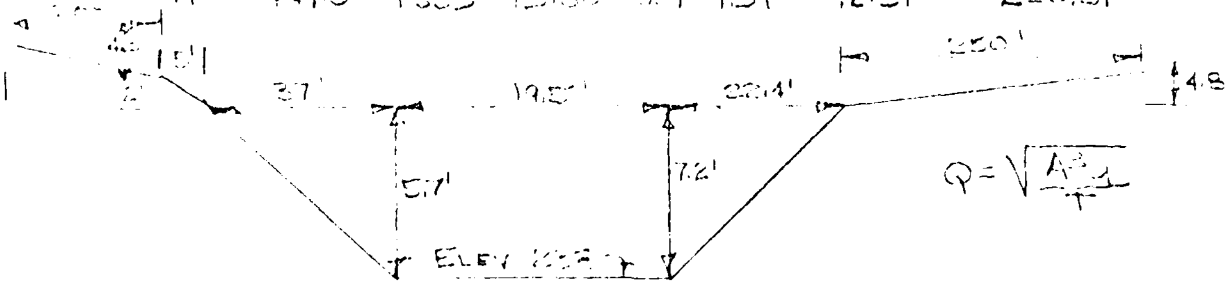
W_b = 40% OF 140 = 56 FT, Y_0 = 25

$Q_{P1} = 1.68(56)(25)^{3/2}$

Q_{P1} = 11,760 CFS

STEP 3 STAGE DISCHARGE AT BREACHED DAM AT LOWER SPRAGUE RESERVOIR (CRITICAL FLOW)

ELEV	DEPTH	TOP WIDTH	AREA	Q_c	V_c	h_{vc}	$d+h_{vc}$	RES W.S.
238	0	19.5						
240	2	36.7	58.2	405	6.96	0.75	2.75	240.75
241	3	48.3	101.7	827	8.22	1.05	4.05	242.[illegible]
242	4	57.9	154.[illegible]	[illegible]	[illegible]	1.33	5.33	243.33
243	5	67.[illegible]	217.[illegible]	[illegible]	[illegible]	1.61	6.61	244.61
244	6	76.[illegible]	29[illegible]	[illegible]	11.0[illegible]	1.91	7.91	245.91
245	7	91.6	[illegible]	4444	[illegible]	2.26	9.26	247.31
246	8	1[illegible]	470	4894	10.41	1.68	9.68	247.67
248	10	[illegible]	94[illegible]	[illegible]	9.51	1.40	11.40	249.40
249	11	441.0	1305	13180	9.87	1.51	12.51	250.51

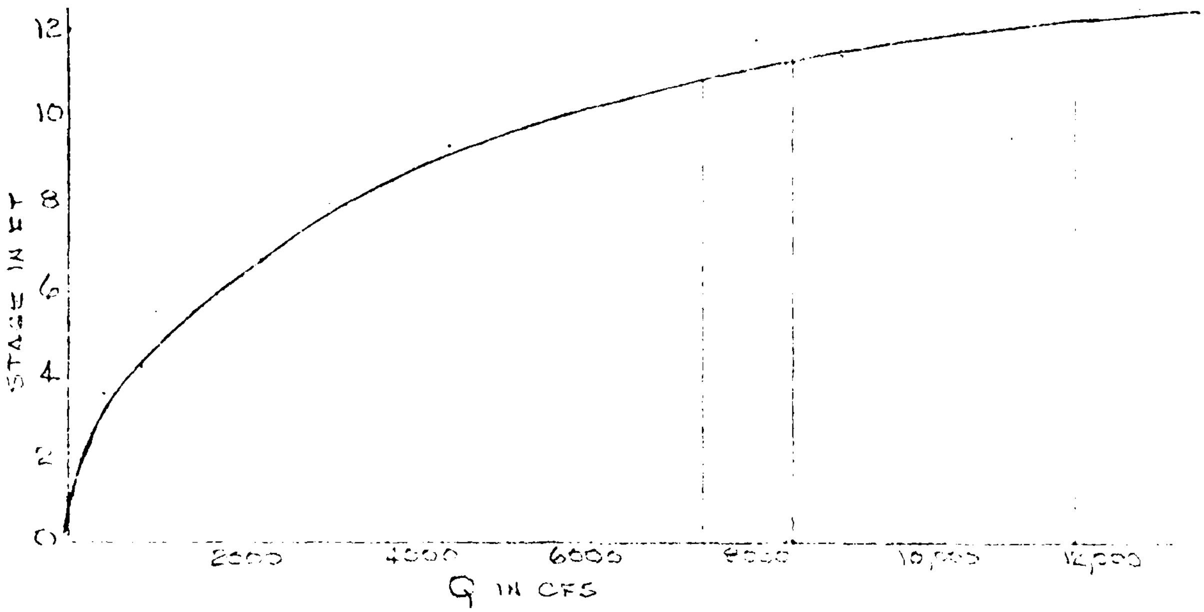


$Q = \sqrt{\dfrac{A^3 g}{T}}$

BY [illegible] DATE 4/[illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO ______ OF ______

CHKD. BY ______ DATE ______ [illegible] PROJECT ______

SUBJECT [illegible] SPRAGUE [illegible] – [illegible] HAZARD

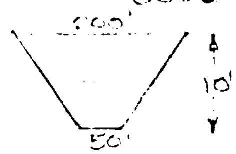


AT Q_{PI} = 11,760 H = 12.2 FT ELEV = 250.2

REACH BETWEEN LOWER SPRAGUE & STILLWATER RESERVOIR

$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ n .045 $S = \frac{1}{3000}$ $S^{1/2} = 0.084$

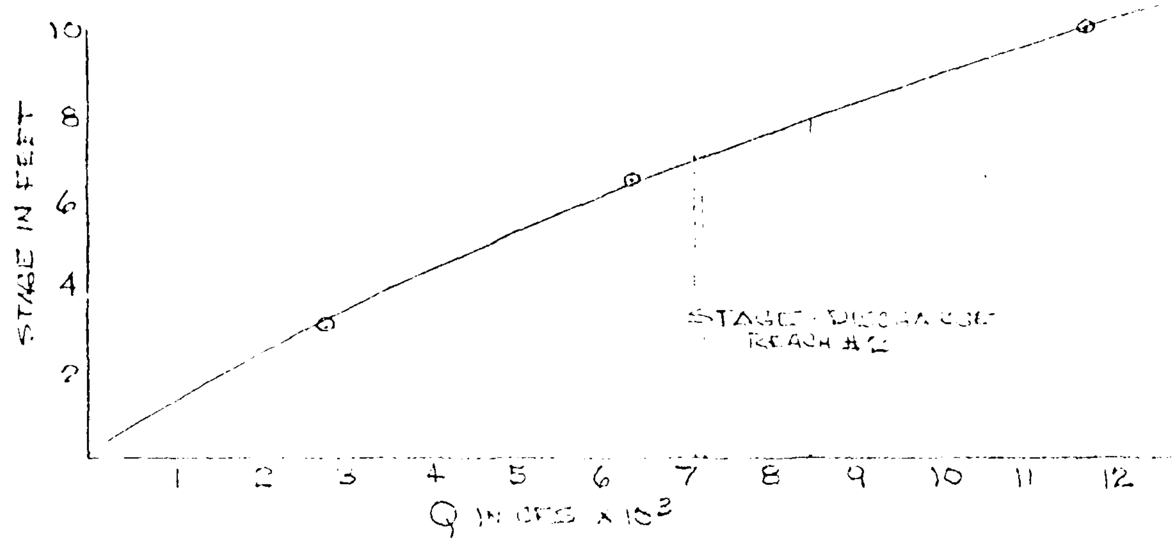
$Q = 2.77\, A R^{2/3}$



DEPTH	WIDTH CHANNEL	Δ AREA	Σ AREA	W.P.	R	$R^{2/3}$	Q
0	50						
5'	125	438	438	125.6	3.49	2.30	2790
10'	200	812	1250	201.[illegible]	6.21	3.38	11,703
15'	275	1188	2438	276.8	8.82	4.30	29,309
7.5	162.5	360	798	163.4	4.88	2.88	6366

LOUIS BERGER & ASSOCIATES INC.

BY ____ DATE ____ SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ PROJECT ____
SUBJECT ____



ESTIMATE REACH OUTFLOW FOR REACH #1 ABOVE
LOWER [illegible] OUTLET
LENGTH - 4800 FT
STAGE 12.2 FT, AREA ≅ 1226 ∴ 135 ACRE-FT = V_1
$V_1 < \frac{1}{2} S$ ∴

STAGE 12.2 FT, AREA ≅ 1226 ∴ 135 ACRE-FT

$Q_{P2}(\text{TRIAL}) = 11{,}760\left(1 - \frac{135}{364}\right) = 11{,}760\,(1 - .371)$

$Q_{P2}(\text{TRIAL}) = 7397$

STAGE 10.8 FT ∴ AREA ≅ 612 ∴ 68 ACRE-FT

$V_{AVE} = \frac{135 + 68}{2} = 102$ ACRE-FT

$Q_{P2} = 11{,}760\left(1 - \frac{102}{364}\right) = 11{,}760\,(1 - .280)$

$Q_{P2} = 8467$ CFS

STAGE = 11.2 FT ELEV 249.2

BY RFP DATE 4/12/81 LOUIS BERGER & ASSOCIATES INC. SHEET NO. ____ OF ____
CHKD. BY ______ DATE ______ INSPECTION OF DAMS - CONN & RI PROJECT ______
SUBJECT SOUTH SPRAGUE RESERVOIR - DOWNSTREAM HAZARD

ESTIMATE REACH OUTFLOW FOR REACH #2 BELOW LOWER SPRAGUE OUTLET

REACH LENGTH = 3000 FT

$Q_{P1} = Q_{INFLOW} = 8467$ CFS

STAGE = 7.9 FT AREA ≅ 862 ∴ 59 ACRE·FT

$$Q_{P2}(\text{TRIAL}) = 8467\left(1 - \frac{59}{364}\right) = 8467(.838)$$

Q_{P2} (TRIAL) = 7095 CFS

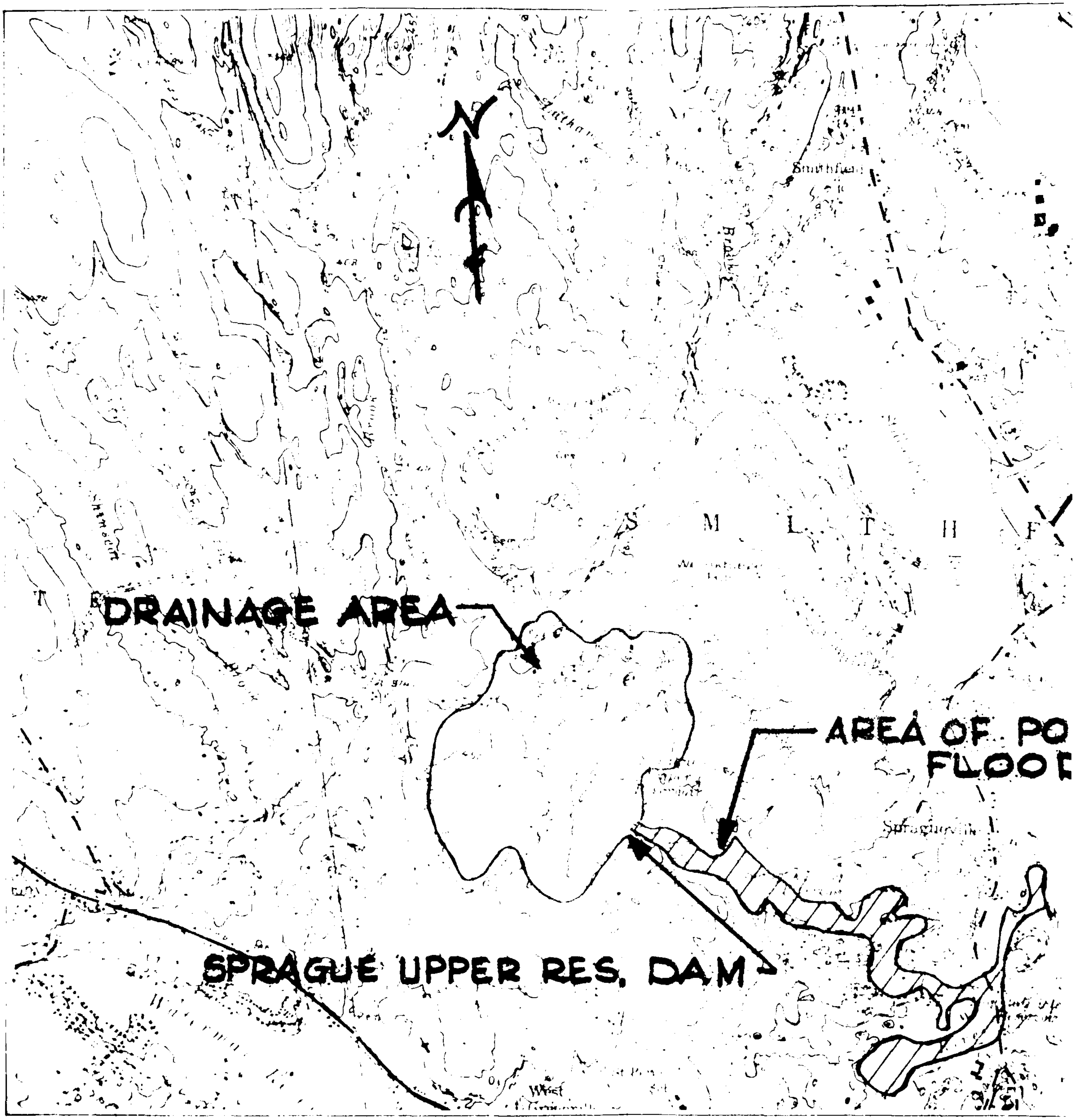
STAGE = 6.9 FT AREA ≅ 703 ∴ 48.1 ACRE·FT

$$V_{AVE} = \frac{59 + 48}{2} = 54$$

$$Q_{P2} = 8467\left(1 - \frac{54}{364}\right) = 8467(.852)$$

$Q_{P2} = 7214$

STAGE = 8.0 FT


N
S M I T H F
DRAINAGE AREA
AREA OF PO
FLOOD
Spragueville
SPRAGUE UPPER RES. DAM

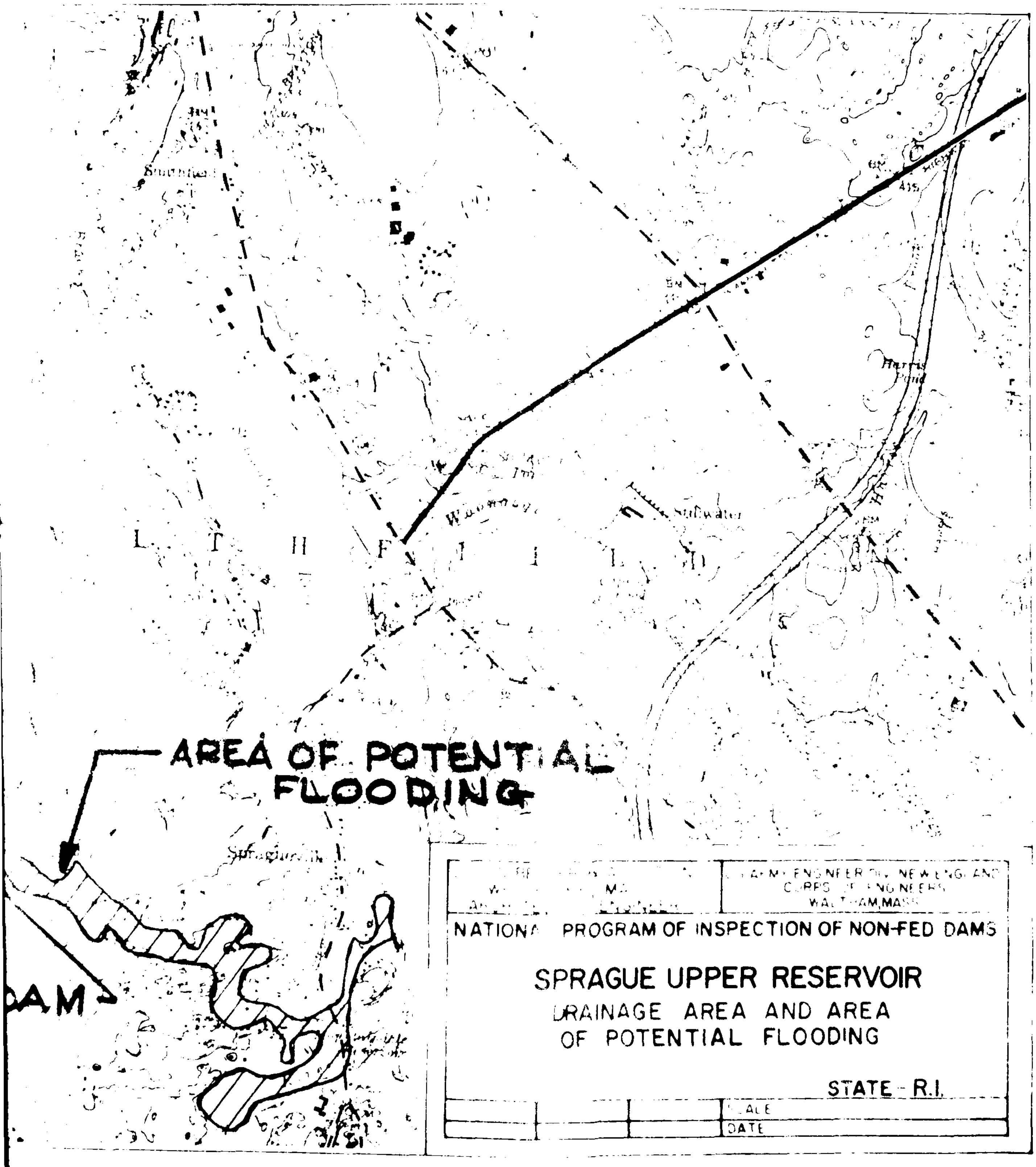


Figure 4, Sheet D 18

APPENDIX E

INFORMATION AS CONTAINED IN THE

NATIONAL INVENTORY OF DAMS

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